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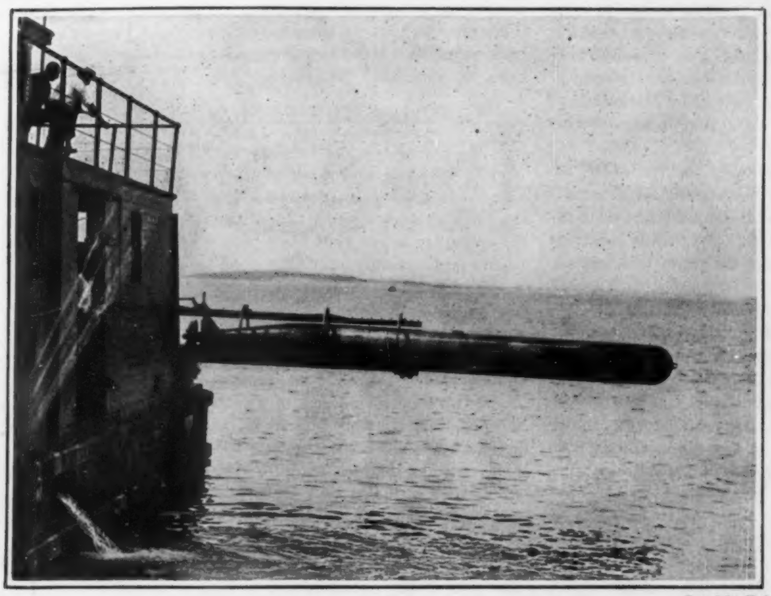
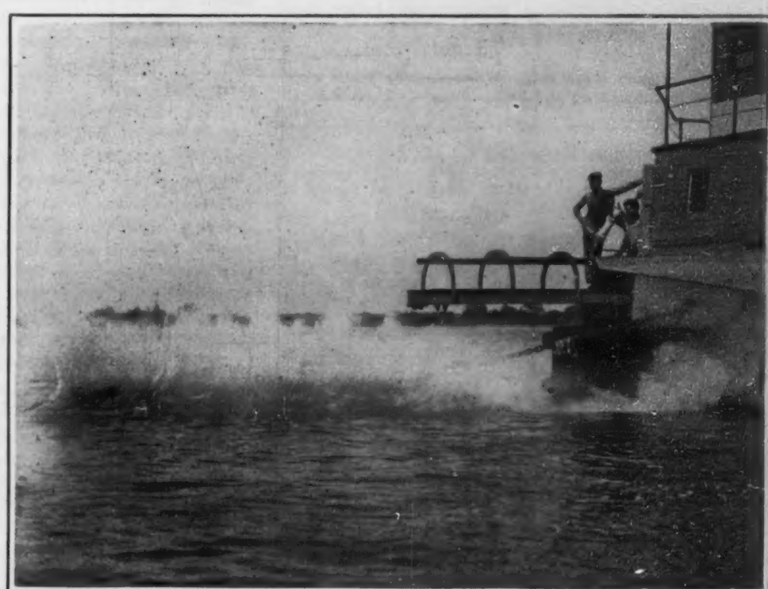


The torpedo has just been ejected from the tube and is about to make its plunge into the water



After discharge, showing the splash and wake of the torpedo as it starts on its course

The Testing of Torpedoes

THE censored photographs which accompany this article have particular interest just now, when the submarine attack on merchant shipping is being carried on so furiously. The torpedoes and the testing apparatus herewith shown, however, are not German but American, for our pictures represent the equipment with which "Somewhere in the United States" the Navy Department puts its torpedoes through their paces before they are accepted for service.

The torpedo is nothing more or less than a miniature submarine which drives, steers itself, and fires its high explosive, automatically. It is an extremely complicated piece of mechanism and is composed, if we remember rightly, of 2,600 separate parts. The mechanism, both for the control of the depth and for keeping the torpedo on its true course, is complicated, and can be depended upon to function with accuracy only if it is excellently made and most carefully adjusted. It is largely for the purpose of making these adjustments, that the torpedoes are subjected to the course of tests as represented in our illustrations.

The testing plant consists of a stout barge, apparently of reinforced concrete construction, which is housed in, and provided with the necessary tools and appliances. At one end of the barge is mounted a special, rotating torpedo tube, corresponding broadly to the launching apparatus mounted on warships, but containing special features suited to this experimental work. In these tests the mechanism of the torpedo is so adjusted that it will run only for a determined distance, when it will come to the surface and may be taken in tow and brought back to the testing barge. It is needless to say that in these tests a light false head is substituted for the high explosive warhead.

The necessity for close adjustment will be realized if we bear in mind that the latest torpedoes have a range of 10,000 yards, and that experiments are in progress which aim at greatly increasing even that extended range. The slightest deviation, of course, would mean a miss; for the average target is only from 300 to 600 feet long.

It is difficult to score a hit at 5,000 yards or over against a moving ship. The ship's course and speed must be estimated within a close margin of error; and, if the torpedo does not run a true course, hitting becomes a matter of luck. The frequent misses by German torpedoes are proof of this.

Interior view of torpedo-testing barge, showing torpedo tube with breech open to receive torpedo

Sirup of Grapes as a Substitute for Sugar

THE great scarcity of sugar in the district of Turin, as well as in the entire Kingdom of Italy, and the government prohibition of its use in wine-making processes, has effectually drawn attention to the sweetening methods which were employed during the economic crisis of 1790-1800, when it was found that sirup of grapes furnished a fairly satisfactory solution of the problem. The matter perhaps is of equal importance at present.

The experiments carried out at the period mentioned, although of great benefit, did not meet with all the success desired on account of imperfect elimination of acids, and the unpalatable character that the process of extraction imparted to the sirup. Although it is now recognized that sirup of grapes can not take the place of sugar for general purposes, it is an excellent sweetening for jam, marmalade, etc., increasing their nutritive value. It is thought in Italy that a commerce in such products might be built up.

For the extraction of the sirup of grapes it is of the utmost importance to use well-matured fruit, and alcoholic fermentation must not occur during the process. As it is difficult to insure such conditions with the liquid in a state of repose, and as it is desired to delete all solid particles, and albuminous and pectic substances, it is necessary to use centrifugal force, by means of which 75 per cent of the deleterious substances can be eliminated. It is also important to avoid any undue action of the press, which would tend to enrich the liquid at the expense of the extracted substances. A natural flow of juice should be sought, the liquid basis being contained in a receptacle furnished with a false perforated bottom. The liquid that issues from the channel of the apparatus is very sweet, and comes from the surface.

This operation must be well regulated, so that the action is effective both as to quality and quantity of the product. Any liquid which remains in the receptacle after the conclusion of the process of extraction may be fermented separately. The issuing liquid feeds the centrifugal machine continuously. Should the output of the latter diminish, the incoming flow of liquid should be arrested, and the plate cleaned; in a few minutes the machine will again be ready to work. The liquid so obtained is poor in fermenting elements, and in order to ensure its preservation for several months, from 100 to 150 grams of sulphate of potash per 100 hectoliters of liquid may be added; or the direct system of sulphurization may be adopted, using sulphuric gas obtained from the combustion of sulphur. The latter method is considered to be most advantageous, at least under present conditions, in view of the high price of potash. This process costs only a cent of two per hectoliter. By repeated trials it has been perfected, and apparatus has been brought out which avoids the use of potash in wine-making processes.

Wool from Basalt

AN American firm operating in Australia has started works near Melbourne for turning the local basalt into "mineral wool" for use as an insulator in packing machinery and ice chests and as a substitute for asbestos. The basalt is melted down with a proportion of freestone and limestone and then steam, at an immense pressure, is forced through the fluid. The liquid rock, thus aerated, flies into the air and falls in flakes on the floor.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

German Reserves in Men

THE war will be won when the fighting power of Germany has been destroyed and its vast military organization so completely shattered that it will be impossible for the Central Powers to continue the war. We speak of the German military power; for Germany has such complete control of her Allies that the war is, first and last, a German war and, whatever may happen to Austria, Bulgaria or Turkey, the war will end only when Germany cries "Enough," and announces that she is ready to meet the victorious Allies in a conference of peace.

The United States has entered the war with the determination to hasten this ultimate and inevitable overthrow of the German military machine. We do not know what kind of information German sympathizers in our country are sending to Germany; but if they tell the truth as it is revealed day by day before their eyes, they will let the Fatherland know that the United States is in this war with the grim determination to see it through to the bitter end.

But how shall the military collapse of Germany be brought about? It has long been our conviction that the German fighting line will collapse when the German High Command is no longer able to provide sufficient reserves of men to keep that line up to its full fighting strength; in other words, that Germany will fail through lack of man-power. In saying this we are well aware that there are many other contributory causes which will hasten the ultimate *debacle*. During the progress of the war predictions have been made that this and that cause must bring about the early defeat of Germany. She would become financially bankrupt. She would be unable to manufacture the materials of war in sufficient quantities to meet the ever-increasing demand. The blockade by sea and land would lead to the early starvation of the German people and call forth a nation-wide demand for peace, so insistant that even a proud military autocracy must bow to its demand.

It is undeniable that all of these conditions combined have brought a fearful strain on the German people; nevertheless there is no good reason to believe that any one, or all of them together, will be sufficient to bring about the collapse of the German army; as the following considerations will show:

So clever has been the handling of the financial situation, so thoroughly disciplined are the German people, and so absolute is their faith in the Government that, after more than three years of war, there is no sign that the Germans have lost faith in the ability of their Government to finance the war as long as it shall last. The German claim that the financial situation is strong by virtue of the fact that the money is being spent within Germany, is perfectly valid; and so long as the German people are willing to accept Government paper at its face value, the present methods of financing the war can go on indefinitely.

As to the question of munitionment, Germany possesses an abundance of the principal raw materials: iron, coal, coke, limestone, etc., for the manufacture of all the shells and guns required for defensive warfare. Apparently she is getting all the nitrates she needs from the atmosphere and, except possibly for a shortage of fats, she seems to be able to turn out a sufficiency of high explosives. True, she is outmatched in gunfire on the Western front, where the ultimate decision will be made; but thus far she seems to have been able to make sufficient provision for the defensive trench warfare to which she is now committed.

As to the matter of food, Germany is certainly not starving. She is on very short rations, it is true, and, for the German citizen, who had been used to his four sumptuous meals per day, the present conditions are very distressing. But there is sufficient arable land within the battle lines of the Central Powers, including the fertile soil of Rumania and the vast area of Poland, to provide enough food to keep soul and body together, and to give the fighting men a sufficient ration to maintain them in good physical shape.

As to the morale of the German people as a whole, we must not be misled by the activities of the Socialists and the so-called Liberal element into the belief that the recent agitation represents the attitude of the great mass of the German people. Not only has the German citizen been taught, from childhood, to believe in the absolute infallibility of the Government; but we must bear in mind that the situation, as we know it, is very different from that situation as it is officially made known to the people. They are told to "look at the map," and they know comparatively next to nothing about the successive series of the crushing defeats which have been suffered by the very flower of their army on the Western front; defeats which have been so manipulated by the Government-controlled press as to take on the color of victory. Similarly, the losses of the Allies through submarine warfare are greatly magnified, and the German people are being told that, although the submarine has not yet paralyzed the military strength of the Allied Powers, it is only a question of a few months' time before it will—and this the great mass of the people undoubtedly believe.

There is one avenue of approach to the heart of Germany, however, down which the specter of ultimate defeat is marching with a fateful tramp that is perfectly audible to the ears of the Kaiser and his military advisers. We refer to the fearful exhaustion of German man-power.

The Intelligence Service of the Allied Powers has remained, throughout the war, in very close touch with the conditions of German recruitment and reserve. It is known to them that, more than once of late, Germany has gone through her available military manpower with a fine-toothed comb; that she is placing at the front every individual, from the youngest to the oldest, who, by the most liberal test of eligibility, can be used on the battle-line or immediately behind it; and the Allies have come to the conclusion that it is in respect of her depleted manhood that the German Empire is doomed to ultimate breakdown. There is no better proof of the dire straits of the German army than the fact that, during the present campaign, boys of the 1919 class have been taken prisoners; for this proves, if it proves anything at all, that the German High Command is being compelled to draw heavily upon its steadily diminishing capital.

To maintain a modern army in first-class fighting shape in the field, it is necessary to have vast reserves back of the line, from which to fill up the huge gaps torn in them by the furious attacks of the enemy. During the fighting on the Somme, and in the campaign of 1917, whole divisions of German troops have been so decimated and their morale so broken that they had to be retired from the front and their numbers made good from such material as was available from the reserve. This reserve is made up of the young men (called out, as we have seen, some two years in advance of their time) and from the wounded soldiers who have been discharged from the hospitals.

Something has been gained, doubtless, by the enslavement of the people of the conquered countries, who have been put forcibly to work in order to release an equal number of able-bodied men for the fighting line; but in view of the enormous scale of the war these supplies are comparatively insignificant.

Now, this sort of thing cannot go on indefinitely; for not only are the attacks of the Allies increasing in strength and destructiveness, but the appearance in the trenches, next spring, of an American Army, one million strong, will greatly intensify the pressure. The argument is made, and it is well founded, that the war has become one of attrition of men, and that the ultimate overthrow of the German military power from this cause may just as well take place in France and Flanders as on the Rhine, or in the heart of Germany itself.

The Wires and the War

ONE aspect of the construction of the new army cantonments, aviation fields, naval bases, and other government war projects to which attention has not been called is that of electric communication. Every one of these places must be in constant contact with Washington, and it must at least be possible to establish contact between any two of the stations. This involves a very heavy program of construction, enlargement and inflated operation, on the part of telegraph and telephone companies.

One of the biggest undertakings has been in connection with the "toll switchboard" at Washington, through which all long distance calls, both incoming and outgoing, must pass. The third addition since February is now being made here, and will when complete make the capacity of this board 220 per cent of what it was in the month mentioned. At the same time a great deal of local switchboard and cable work has been called for by the heavy increase in inter-department calls.

The location of the army cantonments in most cases some few miles from the nearest city has necessitated the installation of long cables containing from fifty to a hundred pairs of wires, putting the camp switchboard in contact with the national telephone and telegraph system at the city. In addition to all this permanent work, temporary facilities had to be furnished the contractors engaged in construction work. The demands upon the resources of the companies in the way of receivers, transmitters, batteries, and other items of small equipment can better be imagined than described.

The whole record of emergency work in establishing the communications which we have specifically mentioned, as well as those for aviation fields, bridge and water supply guards, manufacturing plants engaged in special war work, railroads involved in the movements of troops, coast defense projects, etc., has been a highly creditable one. The work of the telegraph and telephone companies touches the war at every point, and it is a striking tribute to the science of communication that a country so vast as the United States can be so closely knit together by its hundreds of thousands of miles of wire.

Things That Fall from the Sky

PROBABLY the most remarkable thing about the many reported showers of such objects as fish, frogs, toads, and the like is the skepticism with which the accounts of these occurrences are greeted. The wonder is not that they occur, but that they are so infrequent. Everybody has seen the wind carry away, to be deposited in parts unknown, such light objects as leaves and scraps of paper. Everybody has also heard, at least, of the astonishing feats performed by tornadoes and hurricanes in transporting much heavier articles. For example, at Beauregard, Miss., April 22d, 1883, the solid iron screw of a cotton press, weighing 675 pounds, was carried 900 feet. On another occasion a hencoop weighing 75 pounds was transported four miles. In a tornado at Mt. Carmel, Ill., a piece of a tin roof was carried 15 miles and a church spire 17 miles. What goes up must come down. We know, from the facts first cited, that the fall of so light and common an object as a frog, for example, must happen rather frequently in any part of the world subject to high winds.

In the May number of the *Monthly Weather Review*, Mr. W. L. McAtee, of the U. S. Biological Survey, presents an interesting digest drawn from a wide range of literature, of the facts and fables hitherto recorded concerning showers of organic matter. In many of these cases facts and fables are intermingled. For instance, various kinds of red rain are known to occur, but they have been erroneously described as showers of blood; deposits of pollen are described as sulfur; showers of "worms" are sometimes reported when heavy rains or melting snow by saturating the soil have driven the larvæ of soldier beetles or other insects out of their hibernating quarters, and so forth.

Blood rains figure in all the ancient and medieval chronicles and so what goes under this name must be a fairly common phenomenon. "Some blood rains," says Mr. McAtee, "have been found to be the meconial fluid ejected by large numbers of certain lepidoptera simultaneously emerging from their chrysalides; other red rains are due to the rapid multiplication in rain pools of algæ and of rotifers containing red coloring matter; 'red snow' results from the presence of similar organisms. But in no case have they rained down, except in the sense that their spores or eggs have at some time been transported, probably by the wind."

Reddish dust is, however, frequently brought down in rain and some so-called showers of blood may be thus explained. Pollen, especially from coniferous trees, is often deposited in abundance over extensive areas. A pollen shower at Pictou, Nova Scotia, in June, 1841, was so heavy that bucketfuls were swept up on the deck of a ship. Pine pollen is highly inflammable; hence its occasional identification in the popular mind with "brimstone," and a belief in its diabolical origin.

Showers of "flesh" are deposits of a glairy substance which, upon drying, forms a sort of skin on its surface. It is probably, in most cases, the material known as zoöglœa, formed on the surface of water where bacteria are actively multiplying. Other rains of "flesh" or "jelly" consist of the dried spawn of fish or batrachians, the egg masses of midges, or colonies of infusoria.

With regard to larger forms of organic matter many rains of fishes, frogs and toads have been described in recent as well as ancient times and by eye-witnesses of unquestionable veracity. M. Mauduy, a French naturalist, saw in 1822 a heavy shower of rain in large drops, mixed with toads the size of a walnut. This occurred more than a league from any brook, river or marsh. Showers of fish have been reported many times in the United States, in 1893 at Winter Park, Fla., in 1901 at Tillers Ferry, S. C., etc. In the *Monthly Weather Review* for May, 1894, it was even recorded that during a severe hailstorm at Boving, eight miles east of Vicksburg, Miss., a gopher turtle six by eight inches, entirely encased in ice, fell with the hail.

Naval and Military

Digging Out the Germans.—Somebody, certainly no friend of the Allies, started not long ago, a campaign designed to force the Allied fleets to go in and attack the German bases. In these days of the mine, the submarine and the heavy, long-range gun, practically the only result of such an attack would be a frightful loss of Allied warships. The German coast defense system is probably the most perfect work, naval or military, in the whole German system. Just write it down as absolutely impregnable, and you will not be far from the truth.

Our Engineers in France.—In addition to the nine special railway regiments already enlisted for service in France, the President has authorized the creation of 25 additional engineering regiments. They are to be mobilized at the divisional encampments, and the officers will come mainly from the Engineering Officers and Reserve Corps and training camps, although additional officers may be obtained from civil life. These regiments will be employed behind the battle-lines, in the construction of railways and water supply systems, and the various works covered by this branch of the service.

Smart but Uncomfortable.—There is a widespread feeling in our Army that we should adopt the more comfortable and convenient uniform of the majority of our Allies on the Western front. According to the *Army and Navy Journal* it is considered possible that, soon after Gen. Hugh L. Scott, U. S. A., resumes the office of Chief-of-Staff, he will reopen the matter of the regulation coat for Army officers. The American coat with its stiff stand-up collar and close fit looks smart and soldierly, but for comfort it does not compare with the rolling collar, flaring skirt and large pockets which characterize the foreign uniforms.

British Transport Service.—How great has been the demands upon the British merchant marine for the reservation of ships for purely military purposes, is shown by the statistics of the first two-and-a-quarter years of the war. During that time 8,000,000 men were transported across the seas and over a million sick and wounded. Of supplies and explosives 9,420,000 tons were carried besides 1,000,000 horses and mules, and 47,500,000 gallons of petrol. If the Channel Tunnel had been built in the days before the war, a vast amount of merchant tonnage, now employed on transport service, would have been available for the world's commercial service.

Portuguese Troops at the Front.—The *Army and Navy Gazette* (British) speaking of Portugal's military aid in the war, says that in the supremely great crises of European history the Portuguese have always played a part worthy of their greatest traditions. In addition to opening their harbors to the Anglo-French Fleets they have taken their share in the East African campaign. Last May, Portuguese soldiers took their place with other Allied troops in France, occupying half a sector; now they occupy a whole sector. Not only are the men smart and soldierly in appearance but they represent all classes and are picked men. Therefore, they are of good physique. Besides keeping up this division to full strength, it is believed that Portugal intends to send another division. This would give them an army corps of 40,000 men.

Merchantship Construction.—Allied success in the war depends, first and last, upon the Allied command of the sea. In the early years of the war, Great Britain, and indeed all the Allies, neglected merchantship construction in favor of a warship program designed to render her command of the seas absolutely secure. Now, she is turning her vast shipbuilding plants to the construction of standardized 9,000-ton merchantships, and Lloyd George has stated that within the next 12 months she will add 4,000,000 tons to her merchant fleet. The greatest mistake which Great Britain and her Allies could make would be to build the ships for after-the-war instead of for war conditions, and the most damaging error in this respect would be to keep down the speed. A 14- to 16-knot ship, well armed, is fairly safe against submarine attack.

Results in Reserve Officers' Camps.—The Adjutant General gives the rosters of graduates from the first series of Reserve Officers' training camps. Of the 44,000 initial candidates nearly 27,000, or 70 per cent, won their commissions after three months of intensive training, which included, according to the *Army and Navy Journal*, many days of uninteresting back-breaking physical labor. This is extremely gratifying, for the original expectation was that not more than 25 per cent would qualify as officers. A sufficient number of officers who have had experience in the front-line fighting have been designated by the French War Office to supply at least one officer for each of the 16 cantonment camps in the United States. Already France has furnished specialists in aviation and artillery for the instruction of American officers, and the National Guard officers are undergoing special instruction under these specialists at the War College, Washington, D. C.

Science

New Source of Tannin in France.—The manufacture of tanning materials from oaks and chestnuts, which are plants of slow growth, is responsible for widespread deforestation in France, and accordingly efforts have been made to find substitutes for these sources of tannin among plants of rapid growth. According to a note in the *Comptes Rendus* a promising plant for this purpose is *Rumex hymenosepalum* Torr., the tubers of which contain as much as 28 or 30 per cent of tannin. Recent experiments show that this plant, which has been grown successfully in Corsica and southern France, will also endure the climate of northern France.

Capillary Watering of Plants.—M. Lucien Daniel describes in the *Comptes Rendus* the effects on garden plants of continuous "capillary" watering in place of the intermittent watering ordinarily employed in market-gardening. Vessels with a large surface, filled with water, are placed near the plants and the water is conveyed to the bases of the plants by wicks of wool or cotton, which serve as siphons. The amount of water thus supplied to each plant is easily calculated, and can be readily increased or reduced by altering the number of threads. The advantages claimed for the process are economy of water, no burning of leaves, even when carried out in full sunshine, no washing out of nutritive substances from the soil, and no caking of the surface. In a series of tests with lettuce, chicory and cabbage the capillary method produced much finer plants than other methods of watering. This method was also successfully applied to the germinating of seeds and the subsequent watering of the seedlings, plants being thus produced more rapidly than by other methods. The author believes it would be possible to devise simple appliances for using capillary watering on a commercial scale.

The Effects of Freezing and Thawing on Building Stones are to be tested at the U. S. Bureau of Standards by means of an ingenious form of apparatus designed for this purpose. It is well known that all kinds of stone, slate, brick, concrete, etc., will disintegrate in time when exposed to the action of frost, especially in humid climates, like that of the eastern United States, the action being due to the freezing and consequent expansion of water held in the pores of the material. It is obviously very desirable to ascertain the merits of different building materials as to their susceptibility to such damage, and many tests have been carried out for the purpose. The novel feature of the testing apparatus designed at the Bureau is its rapidity of operation. The apparatus will automatically move a charge of stone, concrete or other material back and forth from a freezing chamber to a thawing chamber at the intervals required to completely congeal and thaw the contained moisture. It is expected that by this means eighty to one hundred freezings can be made in one day, whereas such a test formerly required several weeks. Thus it will be possible to determine definitely the number of freezings required to bring about a certain degree of disintegration. Having obtained this information with respect to a given kind and grade of material, it should be possible, on the basis of climatic statistics, to predict approximately the number of years' service it may be expected to give in a specified locality.

Insect Transmission of Disease.—The latest developments of this subject and some up-to-date statistics concerning it were presented by Dr. L. O. Howard in his recent address as retiring president of the Washington Academy of Sciences. Standard works on medicine published twenty years ago made no mention of insects in connection with the etiology of disease. Up to the present time, according to data compiled from recent literature, discoveries have been recorded of the carriage by insects to man or animals of 226 different disease organisms; 87 organisms are known to be parasitic in insects but not known to be transmitted; and 282 species of insects are recorded as causes or carriers of diseases of man or animals. Among recent discoveries is that of the transportation by wind of the body-louse, the carrier of typhus fever. This is a very important point to consider in sanitary measures. The *Bulletin* of the Pasteur Institute of Paris, for December 15, 1916, contains reviews of no less than 17 papers on the louse in connection with disease; the writers being Japanese, English, German, Swiss, French, Russian and Italian. Another novel subject is that of tick paralysis. The disease occurs in Australia, Africa and North America. A single physician in Oregon has found 13 cases. The attachment of a tick brings about progressive paralysis, involving motor but not sensory nerves. The disease is not infectious, and opinions are divided as to whether there is a specific causative organism, or whether the condition is due to nerve shock. Notwithstanding the great development of this subject, Dr. Howard declares that there is a dangerous tendency to exaggerate the importance of insect transmission, as compared with other modes of infection. He thinks insect carriage must be ruled out in the case of infantile paralysis.

Aeronautical

Women as Builders of our Aircraft.—Among fields which are soon to be thrown open for the first time to American women because of the growing shortage of men in industrial fields, is that of aircraft construction. Fortunately, this is one field in which women are said to excel, especially in the making of wings and wing surfaces. Already one of the leading American aircraft constructors has stated that more than 60 per cent of his employees making wings are women.

Aero Engines with Eighteen Cylinders.—By leaps and bounds the stationary type aeroplane engines are increasing in power rating in the stern competition between the Central Powers and the Allied nations. In England Mr. Louis Coatalen has been doing commendable work along these lines, and among his latest products is the 18-cylinder Sunbeam-Coatalen engine, which develops 475 brake horse-power, and has no fewer than half a dozen magnetos and an equal number of carburetors. The arrangement of the cylinders is interesting: twelve of the cylinders are arranged as in the usual twin-six practice, while the remaining six are arranged in the upper center, forming what is styled the "broad arrow" type.

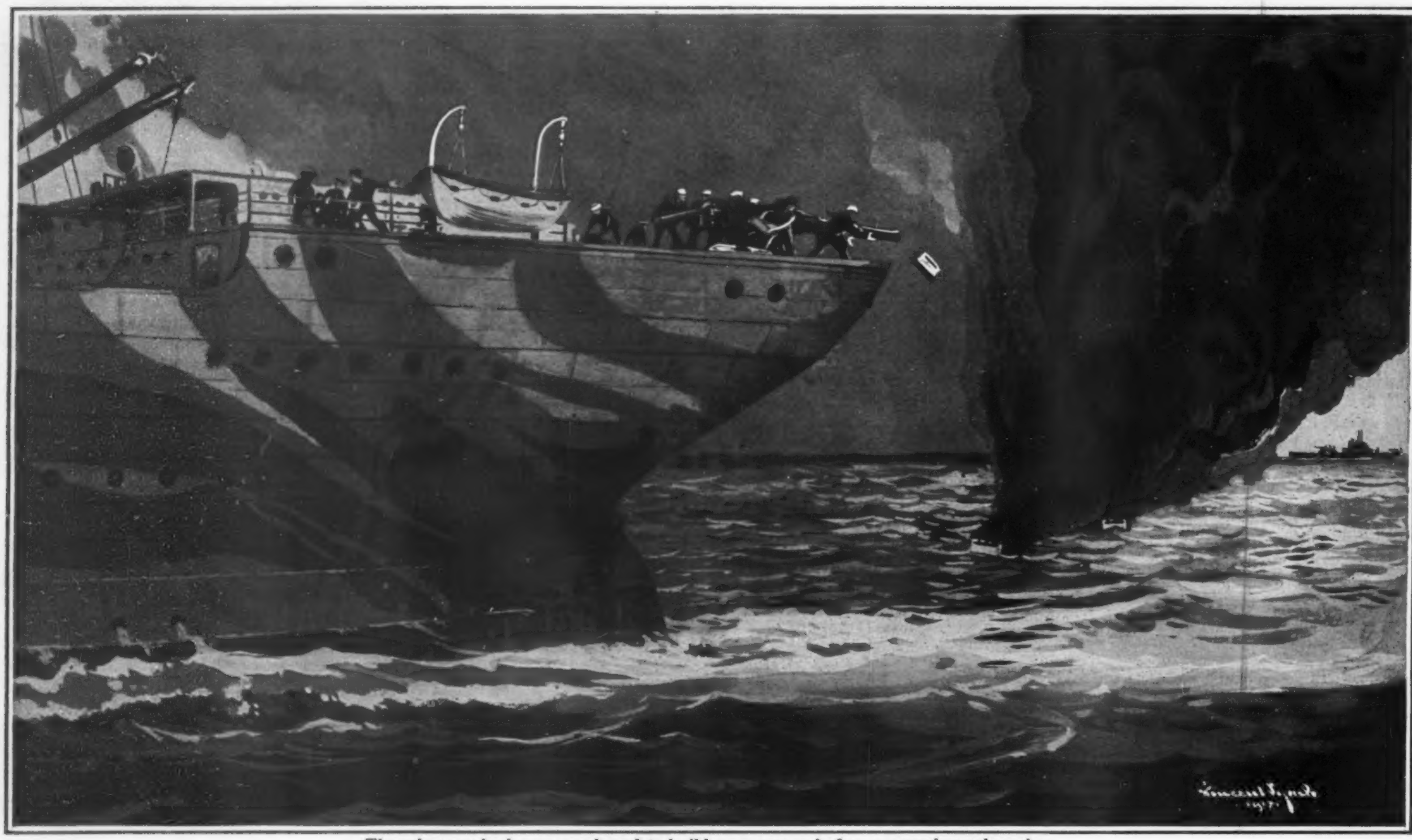
Laboratory for Testing Aeroplane Engines.—At a recent meeting of the subcommittee on power plants of the National Advisory Committee for Aeronautics, preparations were made for the development at the Bureau of Standards of a laboratory for testing aircraft engines under conditions of altitude and temperature similar to those encountered in flights at an altitude of 20,000 feet or more. The laboratory and its experimental equipment will be organized under the auspices of the advisory committee, and the investigations will be directed by the subcommittee on power plants. The special immediate purpose of this proposed equipment is the prompt testing out of the so-called "All America" aeroplane engine now under development, in order to be able immediately to put it under controllable conditions corresponding to any altitude and any atmospheric condition which would be met in the air.

Giant Italian Aircraft.—Ever since entering the war Italy has been quietly developing huge aeroplanes, until the present moment finds that country in the lead as regards super-battleplanes. Typical of Italy's giant battleplanes are the various models of the Caproni type, which are of the biplane and triplane design. Some of these machines have a crew of four or five men, and in addition to this human cargo carry several hundred pounds of bombs. Essentially, the Caproni battleplanes are bombing machines. Recently thirty-six Caproni battleplanes and fast fighting machines made a raid on Pola, the great Austrian naval base, and rained bombs ranging from 70 to 200 pounds on their objectives. Something like six and a half tons of bombs were dropped on the Austrian naval base in this raid. The following night the fleet returned to the attack, and this time succeeded in dropping over eight tons on the Austrians at Pola.

Just How Dangerous is American Aviation.—In an official statement dealing with the mortality in the United States Army Air Service by years, from 1908 to April 28th, 1917, the National Advisory Committee for Aeronautics casts much light on the mortality in this branch of the army. The statement is tabulated as follows:

Year	Number exposed to risk	Number of flights	Total hours in air	Total miles flown	Casualties	Mortality per cent
1908	3				1	33.33
1909	2				0	00.00
1910	1				0	00.00
1911	9	731	129		1	11.11
1912	20	1,498	225		3	15.00
1913	39	3,355	739	39,337	7	17.94
1914	21	2,680	824	49,440	2	09.52
1915	45	4,388	1,814	126,980	1	02.22
1916	96	11,084	5,337	400,200	0	00.00
1917 to April 28th	110	6,306	4,716	353,700	0	00.00

Italy's Quiet Progress.—So much has been written of French, English and German progress in the air that the work of Italy in aeronautics has been overshadowed, believes *Aviation*. Reports now reaching this country indicate that Italy has produced the fastest aeroplane, the best climber, the largest machine and a fleet of dirigibles which have performed marvelous work along the sea coast. As submarine chasers the non-rigid dirigible type has been very effective. Italy is placing the greatest reliance on her dirigibles, and it will be well for the United States to profit by her experience. The secret of Italy's success in aviation is due to the powerful and reliable engines which have been developed. It is asserted that the large Italian engines of 500-700 horse-power have proved that larger aeroplanes than have been thought possible from an engineering standpoint can be built and flown successfully. To demonstrate this point there is under construction an aeroplane using 3,000 horse-power and designed to carry 50 passengers.



Throwing smoke boxes overboard to build up a screen before a pursuing submarine

The Submarine Problem—XIV.

Saving Ships With Paint and Smoke

EVILS, whether social, economic or physical, can be treated in one of two ways—they can be cured or eradicated, or their effects can be minimized.

We *cure* diphtheria, if it hasn't gone too far, with an antitoxin. We *treat* the typhoid patient, and minimize the effects of the germ and the fever as far as we know how. We *eradicate* cholera, by preventive measures.

So far we have no U-boat cure, and no certain method of eradication. We have many methods of minimizing their menace. Unquestionably, there is either a cure or an eradication possible. Hundreds of men are working night and day to find one or the other. But until such a cure or eradication method is found, we must necessarily depend upon such minimizing efforts as skill, brains, and science can suggest.

Of course, a complete cure for sinking ships is found in keeping them at home. But then, no tonnage moves. A partial cure is found in surrounding every merchantman with a fleet of convoys, or constructing three hulls, one inside the other. But the one is too expensive and the other too cumbersome. The cure, when it comes, will be much more radical. For instance, in certain cases it has been found that oil on the water so beclouds a periscope that it cannot throw its image into the submarine. For oil, substitute some substance which would explode on contact with a glass periscope and *with nothing else*, and one has a radical U-boat cure.

But such a preventive is of the stuff of which dreams are made. Those who go down to the sea in ships are depending not upon visions, but upon some intensely practical methods, not of curing the U-boat or driving it from the sea, but of making it so difficult for the submarine to detect and harass its prey that the factor of safety of ocean travel will rise instead of fall.

Such methods are the arming of merchantmen, the employment of speed, the use either of anthracite coal or a smoke preventive method while traveling the danger zone and the two most modern developments of the war—the smoke screen and protective coloring.

It is a curious thing that war on the sea had so many hundreds of years to its credit before any one thought of the use of paint as anything more than a protection against weather. Our battle squadrons were white, once, and no harm done. Battleship gray was next supposed to be the last word in war painting—and a gray battleship is about as invisible on the average horizon as a black aeroplane a thousand feet in the air passing between sun and observer.

It remained for the present war, bringing the strange undersea danger, to evolve those systems of painting hulls in strange colors, in stranger devices, which, so vividly conspicuous at short range, fade gradually into the sea-scape at distances much less than when the ship is painted for peace. Unfortunately, there has not yet been time and opportunity, in this country at least, for a scientific determination of just what the very best "camouflage" painting of a ship may be. Nor is it a matter which can be determined by square, compass, book of logarithms or slide rule! It needs many ships painted in many ways, observed in all weathers, at all distances, at all angles, under all possible conditions of light. In the meantime, practical use is made of such principles as have been discovered.

It is definitely known, for instance, that no ship protection method of painting is the *best* under *all* conditions. Any system of painting must be in the nature of a compromise, just as a zebra's stripes or a lepoard's spots are a compromise. Put the leopard on a plain and he is the most conspicuous animal imaginable. But he can lose himself 20 feet from you in a sunlight spotted jungle. Put the zebra in a jungle and he couldn't hide himself. On a sandy plain, against a bright sky, his startling stripes blend at a distance into a dead grey which makes him, so far as enemies' eyes are concerned, invisible.

What the United States is aiming at, when the War Risk Insurance Bureau of the Treasury Department takes a hand, is *lowered range of visibility*, rather than a complete invisibility. It is obvious that if the range of visibility can be decreased one-half, it will require four times as many submarines to do the present damage.

The War Risk Insurance Bureau has given notice that all vessels sailing to European ports or ports on the Mediterranean coast of Africa after October 1st must be painted in accordance with one of the systems recommended by the Chairman of the Naval Consulting Board and the Ship Protection Committee of the Emergency Fleet Corporation.

But no hard and fast rules for this painting have been drawn up. Four systems are suggested, and the ship owner may select the one which pleases him best, in itself an indication that no one really *knows*, as yet, just which *is* best.

It is obvious that any system of painting which lowers visibility through the use of various colors, can be made a boomerang, if the observer through a telescope can use the right light-ray screens through which to view it. It is conceivable that the protective painting, seen through the proper colors of ray screens, might become extremely conspicuous. Therefore, no public description of the exact colors, curves, areas, proportions, etc., entering into such painting seems advisable. But a word or two regarding underlying principles, so far as they are known, can hardly give that "aid and comfort to the enemy" which a specific statement that such and such a ship is painted in such and such a manner might do.

One system contemplates the use of the primary colors in varied proportions, areas and shapes of area. A gray so produced, seems to have a greater degree of visual "deadness" at a distance, than a gray produced simply by gray paint, just as a zebra's gray of black and white is far less visible than a mule's "all-over" gray. Another system considers that the darkest parts of a ship should be made light and the lighest parts darker, thus eliminating, as far as possible, both high light and shadow. Such a system would paint under the overhang light, and the superstructure darker, to produce a better blend with water and sky. A third system contemplates a wave-like painting of green, blue and white, so that the outlines of the hull are lost in those of the surrounding water. A fourth considers a very important factor—the confusing effect which scrolls and curves have, added to the similar confusing effect of bright colors. It is a fact that a range-finder or a telescope cannot be focused so readily or so sharply upon such an object as upon one which has a monotone color value and sharp clean-cut straight-line outlines.

It should also be noted that there is a third effect aimed at in such "choppy" painting. First, the various colors blend to a monotone which is less visible at a given distance than the same monotone produced by "all-over" painting. Second, the scrolls, curved outlines, as well as the colors, make telescopic focusing more difficult. Third, the breaking up of a solid object into several smaller objects makes it less visible, just as a solid rank of men is a far more conspicuous object than when the rank is scattered. The "choppy" painting, even at such distances as do not produce greatly lowered visibility from color effect alone, does seem to divide the hull and superstructure into several parts, with what may appear as sea or sky between, and these several parts are of lower visibility than the whole hull of one color would be.

The Bureau of War Risk Insurance also requires that vessels sailing for the ports mentioned after October 1st be equipped with at least one dozen smoke boxes of approved design. Much has been said about the smoke screen, and little is really known about it. It is obvious that it can only be used when danger threatens, whereas the protective coloring is only of use in preventing the danger from threatening. To keep a ship consantly behind a smoke screen would be to invite the very danger it aims to dodge.

Smoke boxes are of many designs. One, using phosphorous probably combined with tar or other free carbon

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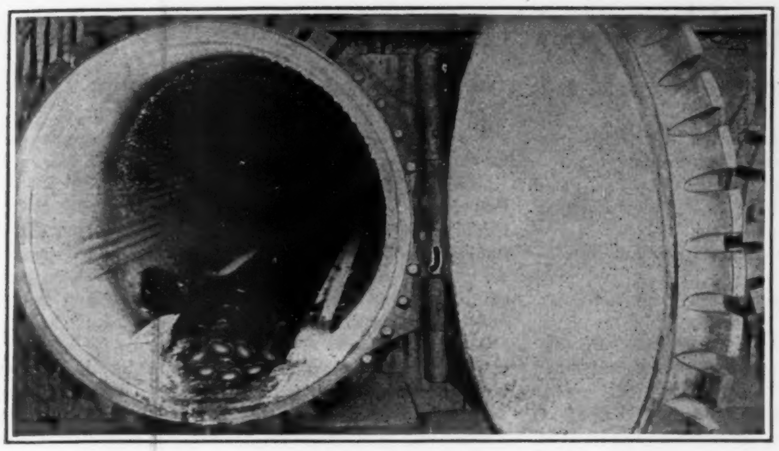
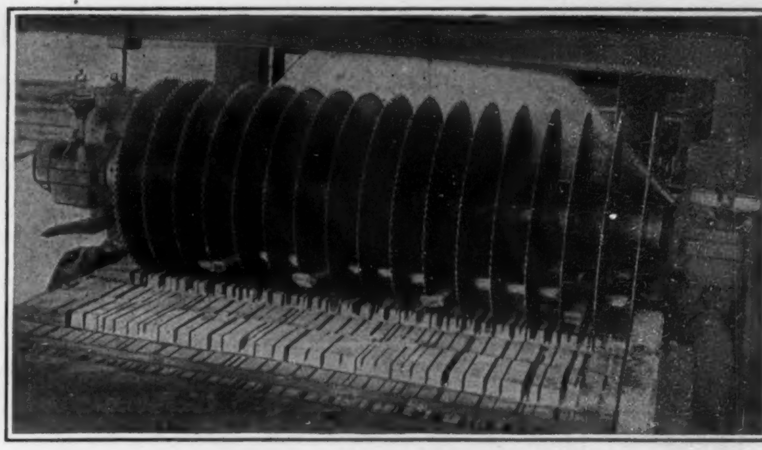


The seven-foot retort, open



The gang-saw that cuts the logs into blocks

Lengthening the Life of Wood

Cooking Logs in Creosote to Prevent the Inroads of Decay

By Ernest Elva Weir

CREOSOTING is a process for treating wood with the object of lengthening its life. In its natural state, cut timber will gradually rot from exposure to the elements or from contact with the soil. This is instanced in fallen trees, railroad ties and the portion of telegraph poles, fence posts, etc., under the ground. Used as piling in salt water, marine worms (teredos) weaken and eventually destroy the wood by honeycombing it with tiny holes.

Tar has long been recognized as a preservative agent and the creosoting process is practically a new and more effective application of an old principle. In the old days, the tar was applied to the outside surface of the wood with a brush; nowadays the same medium is utilized in the form of creosote oil, a coal-tar product, and is forced into the wood under pressure and made to penetrate to a depth of three-quarters of an inch or even more.

As lengthening the life of wood is equivalent to an increase in the visible supply, the creosoting process may rightly be regarded as a most important step toward the true conservation of forest products. The value of the process is being more and more recognized with the increase in the price of lumber and the decrease in the quantity of standing timber.

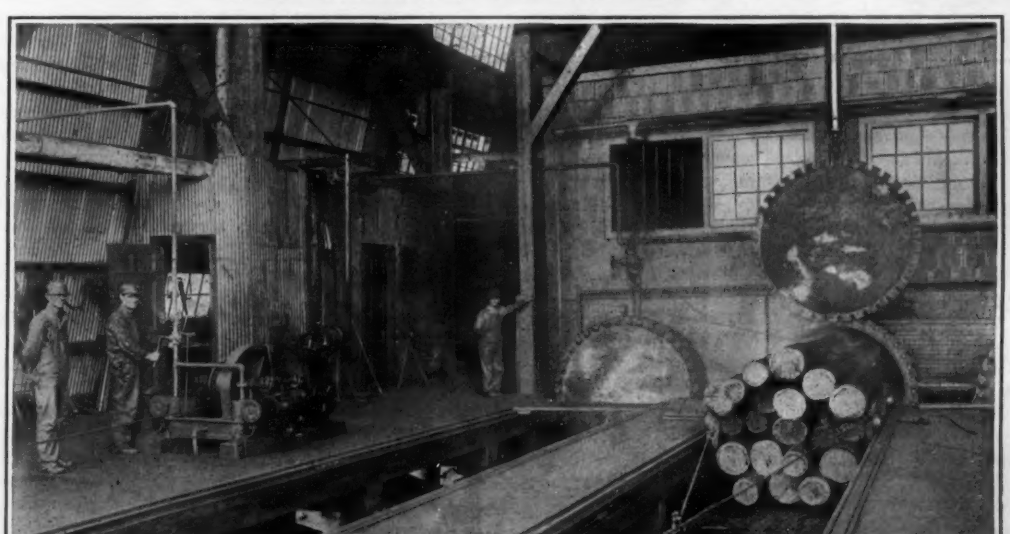
From considerations of economy in transportation, most, if not all, creosoting plants are located on a water front. Nearly all timber to be treated, therefore, is received at the plant in large rafts, or booms, guided to their destination by tugs. These booms contain from 400 to 600 pieces of piling ranging from 50 to 140 feet in length. Sawed timbers are received either in scow loads or by railroad cars. The rafts are broken up in the "booming ground," and powerful machinery lifts the piles from the water to the wharf. Here the knots are trimmed off and the ends squared. The timbers are then measured, stamped as to length and dimensions of butt and point, and stored until needed.

A creosoting plant is innocent of the complicated machinery necessary for the manufacture of most commercial products. What little of the mechanical there is, however, is so interesting and massive as fully to compensate for lack of quantity and intricacy. Perhaps the thing that first impresses the visitor is the large area occupied by the plant, utilized chiefly for the storage of piles and timbers. The particular plant under description has a storage capacity of over 25,000 piles. And then as one wonders how such heavy stock is handled, the question is answered by a powerful overhead traveling crane that passes the onlooker with nearly a dozen 60-foot piles in its grip. Three of these massive labor-saving pieces of machinery travel a third of a mile on tracks 80 feet apart and pick up heavy timbers like so many matches. These cranes perform many duties, they pull the logs out of the water, carry them to the trimming ground, put them into storage, and load them upon steel cradles preliminary to the actual creosoting process.

The chief feature of the plant, however, is a series of steel tubes set in concrete ovens. These tubes, called "retorts," are from 120 to 140 feet long and 6 to 7 feet in diameter. When in operation, they are made airtight by massive steel doors at both ends. The interior of the tubes is equipped with steam coils and numerous inlets and outlets for excess water, vapor, creosote, oil and air.

An open passageway extends a distance of 140 feet from both ends of the retort; it is about two and a half feet deep and five and a half feet wide, the top being flush with the center of the tube. The passage serves as a runway for underslung steel cradles open at each end and provided with wheels operating on tracks at the edges of the well. This track extends through the retort in the form of channel irons bolted to the sides, and continues over the passageway at the exit end of the retort. The logs, piles or ties to be treated are placed on two or more or the cradles and pulled in and out of the retort by a hauling engine. The doors at both ends are closed with fifty large steel eye bolts and everything is ready for the creosoting process to begin.

General view of creosoting plant, showing underslung cradles that carry logs into the retort, and huge overhead cranes that carry bundles of logs from point to point



A charge of logs emerging from the creosoting retort

When received at the plant the lower part of the logs is thoroughly water-soaked while the upper part is almost if not quite dry. The distinctive feature of the best and most up-to-date method of creosoting, therefore, is to steam the timber before permitting it to come in contact with the oil, live steam being admitted to the retort for a period ranging from two to eight hours, according to the size of the material to be treated. This effects an even distribution of the moisture and ensures uniform drying. Excess water that accumulates in the retort during the steaming process is forced into outside tanks, since the pressure in the retort is greater than in the tanks.

After the steaming process, the steam is exhausted down to atmospheric pressure and a vacuum begun in the retort. This is the real drying process and occupies from 12 to 18 hours. Most plants consider 20 inches a good vacuum, but the one visited secured from 24 to 26 inches.

The third and last step consists of flooding the retort with creosote oil; this breaks the vacuum. A pressure is then maintained until the wood absorbs the required quantity of oil, which occupies from three to ten hours. The oil is then forced back to the working tanks from the retort by means of compressed air, the door is opened and the load drawn. A pressure of from 130 to 160 pounds is exerted, whereby the wood absorbs about twelve pounds of creosote

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Plant Products for Every Purpose

How Our War Machinery Will Bring Together the World's Knowledge of Growing Things

THE most direct contact between human needs and the great storehouse of the vegetable kingdom comes through the avenue of foodstuffs. But after we have been fed, and after we have then made up the fibers of hemp and flax and cotton into garments and turned the forest to account to provide lumber and paper, we are far from discharged from all dependence upon plant products. There are gums and resins, rubbers, vegetable fats and oils, vegetable dyes and tannins, cellulose, drugs and herbs, essential oils and perfumes, and, possibly most important of all, the miscellaneous forest products of the sort recently summarized in these columns.

A great number of facts have been discovered about many of these products, but in too many cases even the name of the species from which a given raw material comes is uncertain, obscure, or even unknown. Frequently a great industry buys its raw material from a broker or an importer without knowledge either of the geographic or the specific source. Frequently the supply of some domestic substance depends upon a few ignorant pickers of the plant, turning their gatherings over to some agent who neithers knows nor cares what they consist of or whence they come, so long as his market is assured. In either case, when the source is cut off, as has often been the case during the past three years and as may well become more commonly so, the manufacturer has been placed in an uncomfortable position. Curiously enough, such a predicament is often brought about by the curtailment of a product used in such relatively small quantities that the fact that it is essential to the finished article is overlooked or forgotten during times of plenty.

The number and importance of the instances where our manufacturers have thus found themselves suddenly severed from some accustomed source of supply has been such as to bring this state of affairs to the attention of that busy prescriber for all ills, the Council of National Defense; and the array of its committees has been augmented by the formation of a Committee on Botanical Raw Products. This body is to serve as a clearing house where manufacturers needing raw products of a botanical nature may obtain information regarding them. According to its official announcement, its activities are to be grouped under the following ten headings:

1. The collection of agricultural, botanical and commercial data on all species and varieties of plants having an economic use aside from that as food.
2. Dissemination of such information among importers and manufacturers.
3. Investigation of requirements of the trade for known raw materials, or for materials which come as innovations to the attention of the Committee.
4. The discovery of new geographic sources of plants necessary to the trade.
5. The development of plans for meeting the needs of industry by the cultivation of economically important plants in the United States.
6. The initiation of investigations calculated to discover the true value of conventional equivalents and substitutes for standard raw products of a botanical nature.
7. The discovery of new equivalents and substitutes, and the investigation of their value.
8. The investigation of the requirements of the trade for new raw materials.
9. The suggestion of new species as possibly meeting trade requirements, and the initiation of the proper investigations to determine whether or not they do meet these requirements.
10. The suggestion of new bases for known botanical raw products.

The field which it is thus proposed to cover is one whose great size only the botanically initiated can know. When we say that there are over twenty-five thousand species and varieties of plants now known to have an economic value, exclusive of agricultural and horticultural novelties, the layman will form some idea as to the magnitude of the task which lies before this Committee. Indeed, it would be a long time before the preliminaries were sufficiently cleared up for the Committee to begin active work as a clearing house for manufacturers, were it not for the fact that at the commencement of its labors there is already available a mass of data on special subjects gathered and cataloged at various research institutions. Among these may be mentioned the Philadelphia Commercial Museum, The Laboratory of Economic Botany of the Bussey Institution of Harvard University, The United States Government's Bureau of Foreign and Domestic Commerce, the Laboratory of Pharmacognosy of the Philadelphia College of Pharmacy, the Office of Fiber Investigations of the Department of Agriculture, and the Missouri Botanic Garden. Accordingly the Committee is born full-grown in many departments both of its advisory and of its research capacities.

The Botanical Raw Products Committee, if it is to give the service expected, must have data along five different lines—botanical, agricultural, industrial, commercial and bibliographical.

The correct scientific name of each plant in which the Committee is interested must be known, together with the scientific synonymy, the published descriptions, the original sources, the plates. The common names and the native names are also important. The history of the plant must not be forgotten, and of course a complete knowledge of its geographic distribution is imperative in the first degree.

Agricultural facts necessary to the Committee's purpose are those regarding varieties, their types and origin; cultural requirements, including data on soils and fertilizers, climate, temperature, moisture, planting and cultivation; harvesting and storing; diseases and their treatment; and pests and their control.

The industrial data which the Committee must have under control are still more complicated. Effective knowledge must include all of the economic uses of a plant, and often these are varied as well as numerous. The products go under many aliases, both trade names and native names, and these must all be listed and referred to the proper botanical source. Various methods of preparation must be entered. Data must be assembled on yields, grades and values. The raw products themselves from which a given article is made must be identifiable, and methods of detection must be worked out. And even here the work does not end. Equivalents, substitutes and adulterants must be described and tabled, and their chemistry investigated to a con-

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Bringing in the Foreign Buyer

How Shall We Compete With Europe in This Essential After the War?

AMERICAN exports have made enormous progress during the past two years. But always we have with us the fear that after the war our new trade will be lost. Many means have been discussed for placing our industrial efficiency on a par with Europe's. But we are apt to overlook the fact that selling problems as well as those of manufacturing are involved. After the war our customers will cease to do our selling, and we shall have to do it ourselves.

In this we are greatly handicapped as against the European manufacturer. While we must go out to solicit orders from the foreigner, the foreign customers of the European manufacturer walk right into his office. Wherever the foreigner on pleasure bent lands in England, he is carried by express trains to London, where the English export agent awaits him, to see what he can sell him before turning him over to the continental salesman. When the visitor has crossed the channel he finds that in Paris, France has a drawing power which has made it the world's commercial leader in all trades connected with women's wear. And it is one of the achievements of the new German Empire that it has made Berlin one of the most entertaining cities in the world.

Here in a word, we have one of the keys to European success—amusement. The foreign business man in the beginning came to Europe because he had to or because he wanted to see its sights. Having seen them and found them good, he comes again and again, to escape the monotony of his home atmosphere, to be amused for a few weeks or months, and incidentally to buy. With him his buying is indeed incidental, but with the seller it is far from that. He has bought where he could best make his buying an incident of a pleasure trip; but by so doing, he has made Europe's commercial supremacy.

Just now he is cut off from all this, and buys of us or not at all. But when the war is over, Europe will again exert its old drawing power. Paris will again be the gay city, Switzerland will reopen her doors, with the bridges in her narrow canons freshly painted. And from all over the world, tourists will flock to "do" the battlefields. If then we want to keep our new foreign trade we must make a serious attempt to draw part of the stream of travel away from Europe. We must invite the world to come to us, to visit our beauty spots; and while we have them here we must do our selling. This involves a number of things. It necessitates the finding of beauty spots, their advertising, the perfection of transportation facilities and hotel accommodations. Perhaps most important of all, is the advertising. It is not enough that we be as amusing and as accommodating as Europe. We must make the South American, the Australian, the South African, the Oriental, know and believe that we are so. In a word, we must build up an established tourist industry like that of Europe.

There are a number of points at which beginning could be made. We have in this country some of the most beautiful scenery in the world. With the Grand Canon, the Yosemite, the Hudson and St. Lawrence valleys, the shores of Florida and California, Europe can present no creditable comparison. But we hardly know this ourselves; how then can the foreigner know it? We must advertise in foreign countries. Foreign artists should be invited to paint and describe what we have to show. Foreign travelers of international fame should be encouraged to talk up our beauty spots as we do theirs.

We should also make travel easy. Of course the American in his own country travels in the most extreme luxury. But our personal service is bad. Picture what would happen to a wealthy Brazilian on our trains and in our hotels if his knowledge of English were only on a par with the French of the average American who journeys with comfort through France. His experiences would undoubtedly go far to confirm the general foreign impression that America is a fine country to buy in, if you are rich enough and lucky enough to keep yourself alive while you are buying.

There is still another aspect of the matter. Look back for a moment to the ocean passenger traffic as it was distributed before the war. The very finest vessels which human ingenuity could desire plied between our Atlantic ports and Europe, under French, British and German flags. Ships but little inferior to these, German for the most part, made frequent sailings between Buenos Aires and Rio de Janeiro and the North Sea ports. But passenger traffic between South America and the United States was in the hands of these same German lines, and alike in frequency and in kind the service was distinctly of the second order. An Argentine cattle king, if compelled to go to New York in 1914, would in all probability have made the trip via Hamburg.

Suppose the war were to end today. All these lines would at once go into commission again. Germany, France and England would as before possess a complete monopoly of the business of bringing foreigners to our shores. How futile it is to suppose that under such circumstances our campaign of education could achieve wide-spread results! The most trusting soul will hardly fail to see the absurdity of looking to the German lines to bring to New York and New Orleans a steady stream of traffic which had been carefully diverted by us from European ports. In a word, before the inducements leading the foreign tourist to come to us can possibly surpass those attracting him to Europe, we must have an American merchant fleet.

With such a fleet we should be able to begin a new movement in support of our foreign trade. We should be able to carry our Argentine magnate to Europe via New York, instead of having him make his rare pilgrimages to New York via Europe. We should be in an especially favorable situation with reference to traffic with the west coast of South America via the Canal. We should be able to carry the Asiatic buyer across two oceans and one continent to his European destination. And while carrying the foreign merchant on our ships and railways we should not only have shown him something of our country, we should have impressed him with our bigness, and, most important of all, we should have befriended him. He might buy from us before leaving us, or he might not. But in any event he would take his impressions away with him, and he and his friends would return, eventually to buy.

The principle is sound that in the long run you can sell a man more by having him call on you than by calling on him. It is on this principle that Europe's commercial supremacy is largely based. And if we cannot employ it, if we cannot develop a tourist industry of our own, with all the necessary appurtenances to make it a success, including an American fleet and the ability to talk to the foreigner in his own language on trains, in hotels and in our business dealings with him, we may as well reconcile ourselves to the disappearance of the greater portion of our war-made foreign trade.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

An Official Disclaimer

To the Editor of the Scientific American:

My attention having just been drawn to your Editorial "Norway and the North Sea Net" in your issue of August 18th, I beg to submit the following facts:

Submarines of foreign nationality are strictly forbidden to enter Norwegian territorial waters (on as well as below the surface). Ever since the beginning of the war Norway has been keeping a close watch of her coasts and her territorial waters. The way in which Norway has accomplished this task has won her the unreserved recognition of the British Admiralty. There have been very few cases of German as well as British submarines violating the Norwegian territorial waters. All such incidents have been strongly protested against by the Norwegian Government. Considering the constant watch being kept it is highly improbable that furthere violations than those referred to have taken place and for any one having the slightest knowledge of the Norwegian situation it seems utterly absurd to intimate that Norwegian territorial waters have been used as a thoroughfare for German submarines or as a basis for their operations.

Fridjof Nansen.

The Norwegian Special Mission to the United States.

Shall We Revive the Pneumatic Gun?

To the Editor of the Scientific American:

For a number of years, I have been a subscriber of your valuable journal, and reading an article in May 12th issue on the U-boat proposition, ask you to consider my views. Why not make a cartridge of brass tubing one inch in diameter and ten inches long, with a packing of dynamite or gun cotton, attaching at one end a steel conical detonating cap? By combining six to eight such cartridges and firing from a pneumatic cannon, whenever in range of U-boat periscope, if only one hit is made the boat is sure to be put out of commission. By shooting this cartridge to form an elipse, and gaging the sight so as to drop just this side of the periscope, surely one out of six will make a hit, and it will only take one cartridge to break the outer shell. The rear end of this cartridge should be of three V-shaped thin pieces of brass to serve as a guide.

If I am correctly informed, one can shoot with a pneumatic cannon up to 2,500 meters. In my opinion, this would be the kind of cannon to launch on the 1,000 submarine chasers our government intends putting out. I just advance this idea, and ask you to publish it; possibly some one reading this article could suggest improvements so as to combat this menace to our shipping.

Chas. E. Barmm.

Indianapolis, Ind.

Protective Pessimism

To the Editor of the Scientific American:

I think the country owes you a debt of gratitude for your clear, cool and wise leader of June 2d, with the above title. "Protective Pessimism," hoping the best but preparing for the worst, is the only right attitude. And, as you point out, time and again, Allied overconfidence has been partly if not entirely responsible for subsequent disaster. It also starts periodic waves of reaction and equally great underconfidence, which probably accounts for the gloomy dispatches in the papers today, June 8th, that Russia is finally out of it, all hopes of a decision this year gone glimmering, and that three years of war impend.

This of course is the opposite extreme, and probably quite unjustifiable. Perhaps the unpleasant prospect may have a sobering effect and keep us on a more even keel, determined to see things through, whether it takes three years, two, or, as still equally possible, but one.

John Chetwood.

San Francisco.

The Unsinkable Ship

To the Editor of the Scientific American:

The "Unsinkable Ship" seems to be a "Consummation devoutly to be wished." Can't one be built by simply filling the hold of a vessel a little above the water line with cylindrical cargo containers surrounded by a compound lighter than water, non-inflammable and water proof?

Now wouldn't a vessel's hold treated in this manner render the craft unsinkable? I think it would because there would be no room for water to enter the hull after a torpedo explosion occurred. Such a ship would stimulate recruiting for duty over seas, as our soldiers would not object to a ship that could not be sunk. Just think how many torpedoes the Germans would waste and the surprise they would feel when dozens of shots were fired without results. Wouldn't the Submarine officer come up to investigate and wouldn't his craft be promptly sunk by our able gunners? Think of the hundreds of trawlers that would be rendered safe by such a means, to say nothing of the other ships operating in the danger zone. Doesn't the idea border on the safety first plan? At any rate it is not impossible, as the experiment has been tried and strange to relate it worked.

Let's try it out.

W. W. Storm.

Wilmington, N. C.

The Sewage Waste

To the Editor of the Scientific American:

The letter of Fay McFadden in the June 9th number regarding the criminal waste of the most valuable material in our possession is certainly very much to the point. Not only is there disgusting pollution of the waters around New York, Boston, Toronto, Cleveland, Detroit, and every other city where I ever had to engage in my occupation, but the fact is, if we keep on very much longer we will have to give up city life entirely. The acme of our absurd policy is the dumping of street sweepings out at sea.

The flotsam of this dirt pollutes the shores everywhere. The dirt of Buffalo, Detroit, St. Louis and Chicago comes down the rivers, the filthy slime lies many feet deep in Toronto Bay while Rochester, Milwaukee and Cleveland pollute the clear sweet waters of the great lakes.

Toronto actually drinks the water not far away from the sewer mouth after the medical health officer makes it undrinkable by the adding of vast quantities of chloride of lime. The time is very close at hand when none but the very poorest will live in the cities, the rich man will have his country residence and his auto—this and the good roads enable Kansas City wealthy people to live on from two to five acres out in God's country and go in to work every day.

During many hundred thousand years nature has accumulated a vast quantity of humus but we have used it all up in a century or less; when are we going to stop the frightful waste?

G. H. Corsan.

Evansville, Ind.

Hay Fever

By John Bessner Huber, A.M., M.D.

In the cases of most hay fever victims, two factors obtain: a neurotic idiosyncrasy and an unusually iritable condition of the upper air passages. In reality hay fever is a periodic form of asthma. There is the "June" or the "Rose Cold" in the Spring; and the "Hay Asthma" or "Hay Fever" of which so many suffer during August and September. And I may perhaps best serve my purpose by considering asthma in general, keeping constantly in mind hay fever in particular.

There is probably no human affliction of which the causes are more numerous then asthma. Many of these act directly on the mucous membranes of the upper air passages; others reach indirectly, through the blood, the nervous system that is so fundamentally affected in this disease.

Many unfortunate people have asthma only when they are exposed to some direct cause; others have constantly recurring attacks without any manifest cause. And when, by diligent search, the underlying cause in the latter cases is revealed and eradicated, immense relief and not infrequently cure is achieved.

Among easily ascertained direct causes are nasal polypi, deflected nasal septa, chronic rhinitis, adenoids, enlarged tonsils and other untoward conditions. While such things exist, no hay fever case is ever really cured—palliation only is afforded; whilst vast improvement will follow upon the masterful treatment by the "nose and throat man," though the irritable condition (fundamentally a neurosis) may remain. Then there are all kinds of dust. In street dust under the microscope, one sees all manner of molds, fungi, bacteria and many other most offensive particles both organic and inorganic—fluff from woolen clothing, the dust of mills, foundries, threshing-floors, bake shops and such material as is evolved in offensive trades. Here is a report of a specimen of city dust: plaster, iron-rust, stone dust, cement from building operations, dust from excavations, ash cans, house sweepings, dried garbage blown from barrels and cans, chimney soot and cinder, excrement of horses, dogs and other animals, dried sputum of the tuberculous, the bronchitic—of those having nose and throat catarrah and early pneumonia.

Many odors—of pitch, phosphorus, sulphur—chemical vapors; the emanations of dogs, horses, hares, cats—will excite asthmatic paroxysms. "Some men are mad," declared Shylock, "when they do smell a cat." And Weir Mitchell's cousin, a man in all other respects of most normal temperament, could not endure a cat in the house, let alone its presence visible to him. He could "sense" a cat's being in an adjoining room. And Weir Mitchell based a most absorbing article on Ailurophobia, the fear of cats, upon this phenomenon. Most of all the smells of such plants as ipecac, and of flowers (as oftentimes the rose), the effluvia of certain grasses, weeds and pollens, are responsible for the development of the Rose Cold and the Hay Fever. This relation of the vegetable kingdom to asthma is superbly and most authoritatively dwelt on by Dr. W. Scheppegrell, of New Orleans, in the Scientific American of October 7th, 1916 ("What Plants Are Responsible for Hay Fever"); and in his Reprint No. 349 of the United States Public Health Reports, entitled "Hay Fever and its Prevention."

Climate plays a great part both in the development and in the relief of asthma. Extremes of temperature—excessive dryness, or on the other hand, excessive moisture, may induce the seizure. Thunderstorms are likely to bring on attacks. And hay fever victims know by experience of areas—in the Adirondacks, or the White Mountains or in Canada—to which if they can escape during "the season" they will not suffer; whereas they certainly will, and most lamentably, when they remain in their homes. The coming of frost brings relief to the sufferer.

Asthma may be also aggravated by the presence of one or another lung affection, or by tumors in the thorax pressing on important nerves; people who have had malaria or whooping cough or measles may become susceptible. Heredity and family factors have been traced in 40 per cent of asthma cases. The affliction may "run in families" whose nervous machinery is characteristically unstable; those members who have not asthma may instead have migraine or neuralgia, or neurasthenia or epilepsy. The educated and the highly nervous are prone. Hereditary and family tendency may not manifest itself in asthma until late in life; although the children of asthmatics may have asthmatic paroxysms during attacks of grippe and coryza. In the gouty, asthmatic seizures may alternate with joint affections. Those who have had syphilis in youth may have asthma later in life. Improper diet—sea food especially—and an overloaded stomach, by which poisons from undigested material get into the blood, are very likely to induce seizures. Kidney disease may induce asthma by reason of the circulation in the blood of toxic substances not properly eliminated. Affections—mostly neuralgic—peculiar to women, may provoke asthma. There is an intimate relation between asthma and such skin diseases as eczema and the hives—no doubt also by way of the circulation. Such emotions as anger and fright may bring about paroxysms. And I must emphasize—what the reader has no doubt fully discerned—that aberrations of the nervous system are fundamental in most cases.

In our Southland there are Rose Cold and Hay Fever sufferers all the year round. Women more than men; the young and the middle-aged are most frequently attacked. The tendency is to lessen with age.

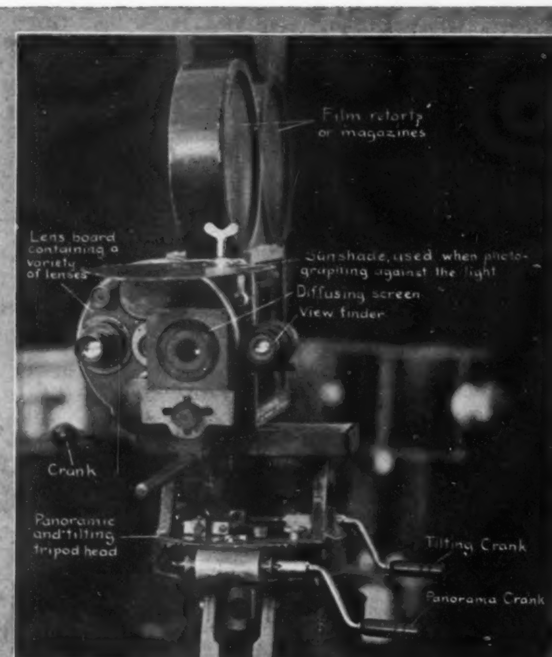
Rye pollen is the most active cause; the ragweed is also very prominent. The severity of the attack is in direct proportion to the quantity of pollen present and floating in the atmosphere. In susceptible folk, no more than two or three tiny pollen grains applied to the whites of the eye or to the nasal mucous membrane promote the characteristic attack.

These causes of asthma are here set down in order that by the elimination of such as may obtain in individual cases of Hay Fever or Rose Cold, relief—and possibly more—may follow.

As all hay fever sufferers know, the disease begins suddenly and often shows a curious punctuality in the date of its annual recurrences. There is a severe coryza with a profuse watery and, rarely, a purulent discharge. The eyes are reddened and weepy; the lids itch. Taste, smell and hearing are much impaired. Cough, sometimes very severe, and excited by a tickling sensation in the throat, is a frequent concomitant. There is some chilliness and fever; and a deplorable deal of headache, lost appetite, disturbed sleep and weakness proceeding to prostration. Many sufferers become dreadfully low-spirited. The attacks are often identical with those of typical bronchial (that is, general) asthma. The symptoms vary from day to day in severity; and the entire attack usually covers from a month to six weeks.

What can be done for such a sufferer? Prevention is best when possible, and this phase of the matter has, in the papers noted, been exhaustively presented by Dr. Scheppegrell.

Remedies to stabilize the nervous system are prescribed by the physician according to the needs of the individual case—arsenic, phosphorus, bromides, etc. Change of climate is best when possible. The dry mountain air is the specific for most; and yet there is no general rule other than what experience furnishes. Some sufferers do very well at the seashore. Thorough local treatment of the nose and throat during the time when there is no Hay Fever or Rose Cold, is most advisable, especially the removal of abnormalities from sensitive areas. Dr. Dunbar has evolved pollantin, an antitoxin from pollen, which is capable in many cases—alas, not in all—of cutting short ordinary attacks. This serum is applied in the morning, to both nose and throat; and again during the day on the slightest evidence of irritation in the conjunctiva or the nasal mucous membrane.



Tools of the motion-picture camera-man—a typical American camera and its accessories

At the left: Camera-man of the American film forces, adjusting the iris diaphragm placed in front of the camera lens for obtaining circle vignette effects. The leaves of the iris diaphragm form any sized opening by moving the lever. *At the right:* A favorite type of camera, labelled so as to indicate its more important members

"Shooting" the Photoplay

An Introduction to the Motion Picture Camera-man and His Art

By Austin C. Lescarboura

MOTION pictures became popular when the camera-man became acquainted with his work. A dozen years ago when the industry was in its infancy the films were of poor photographic quality: they were indistinct; they jumped about the screen in a most disconcerting manner; and they flickered to such a degree that only the strongest of eyes could attend a performance every little while.

Yet the stories these films told were good stories, in many instances comparing favorably with those of today. The fault was clearly not with the stories or the acting. But no audience cares to be discomforted and so it came about that the entire future of the industry—whether it was to be an established, universal form of entertainment or merely a novelty to be displayed to the curious in museums and similar institutions—was placed in the hands of the camera-man. To him was assigned the task of producing good photographs, while the industry awaited the outcome of his efforts.

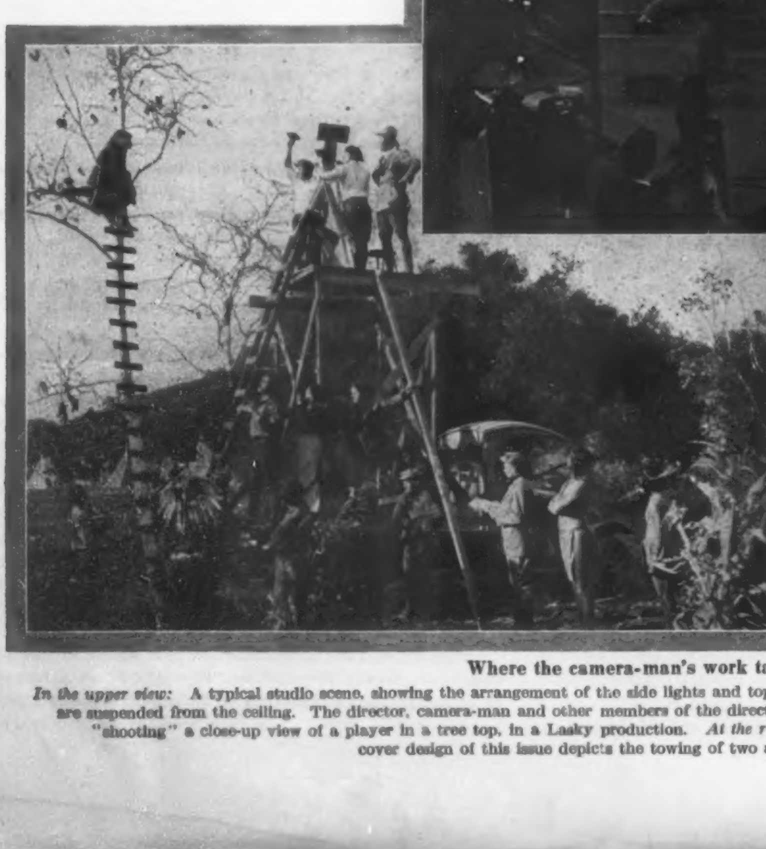
Fortunately the camera-man was not alone in his labors; for the film manufacturer, realizing that the raw film was the very foundation of good photography, worked on his chemicals and methods and emulsions until he evolved a stock which was faster, more reliable, and contained the minimum of grain. The laboratory hands and chemists also contributed to the campaign, and perfected developing methods and improved the printing and finishing of positive prints for projection. Further aid came from cinematograph engineers, who turned their efforts to the end of evolving better cameras, better printing machines, and rock-steady projectors. Finally, optical experts, wishing to prove their battle cry that "It's all in the lens," after a careful study of the peculiar requirements of motion-picture photography contributed their quota in the form of better lenses.

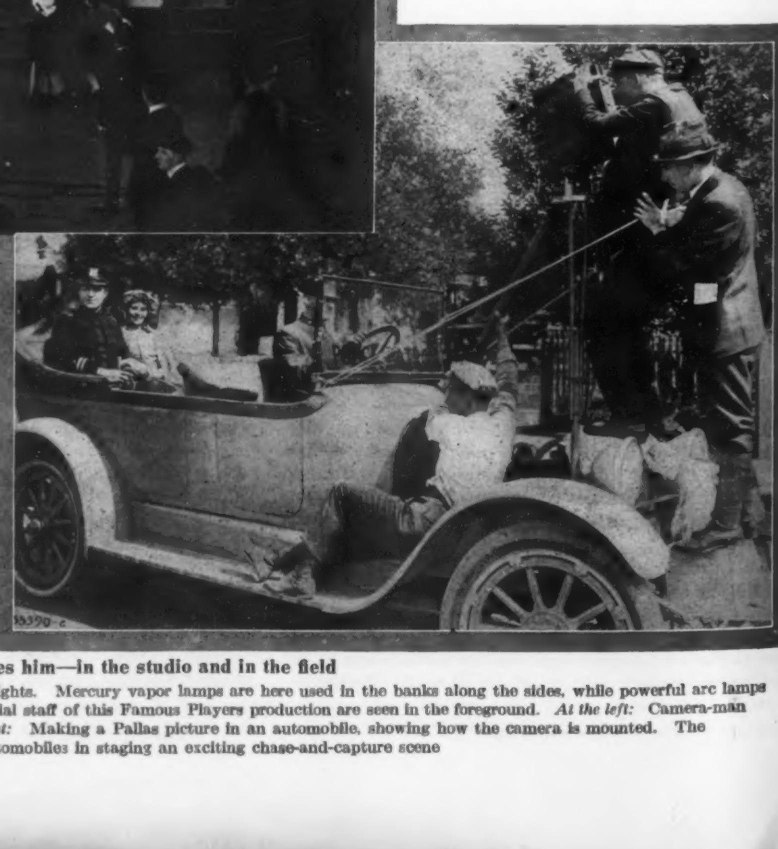
All of which went to place the motion-picture film high in the scale of photographic quality.

One concrete example serves to show what has been accomplished photographically in this, the sixth industry in order of importance in America: Ten years ago a domestic film showing a group of people was so indistinct that the features could not be made out; today, a film scene of a battle, comprising several thousand people, is so clear that every figure can be made out plainly when projected on the screen. And each of these figures appears as a pin-point on the film!

What Is a Moving Picture Camera?

There is nothing mysterious about a motion picture camera, yet the laity is wont to look upon it as a symbol of the black art. Boiled down to its essentials, a cinematograph camera consists of a high-speed lens, a shutter, and a crank-operated mechanism for moving the film down the space of one picture after each





Where the camera-man's work takes him—in the studio and in the field

In the upper view: A typical studio scene, showing the arrangement of the side lights and top lights. Mercury vapor lamps are here used in the banks along the sides, while powerful arc lamps are suspended from the ceiling. The director, camera-man and other members of the directorial staff of this Famous Players production are seen in the foreground. *At the left:* Camera-man "shooting" a close-up view of a player in a tree top, in a Lasky production. *At the right:* Making a Pallas picture in an automobile, showing how the camera is mounted. The cover design of this issue depicts the towing of two automobiles in staging an exciting chase-and-capture scene

Odd moments with the camera-man who records our dramas and our comedies

At the left: An Artcraft camera-man peering through the peep-hole of his camera in order to focus filmdom's leading star on his film. *At the right:* Making a picture in the field for a Pallas production. Here the camera-man is perched on top of the 'bus which serves to carry the players to distant spots or "locations". *Below:* A typical outdoor studio scene in southern California, where the sunlight is used for both interior and exterior pictures. Note the sunlight diffusers in this Pallas studio, which serve to eliminate shadows and reduce the intense light.

exposure. It is nothing more than a high-speed snap-shot camera which makes a large number of photographs every second.

Of necessity the camera contains many refinements. For instance, the film is contained in light-proof retorts or magazines, so that it can be loaded into and taken out of the camera in broad daylight. When placed in the camera the film is threaded through the mechanism and down to a second magazine, or "take-up" magazine, which gathers in the film as rapidly as it is exposed. In focusing the image two methods are available: First, by looking through a peep-hole at the image on either the film stock itself or on a piece of ground glass inserted in the light aperture; second, by a "guess-focus" scale on the lens barrel, much after the manner of the ordinary hand camera. The amount of film exposed is indicated on a dial, so that the camera-man always knows how much film he has left. A punch, incorporated in the construction, serves to put a hole in the film after each scene, so that the laboratory hands may know where each scene begins and ends and in this manner be able to cut the scenes apart and develop each strip separately. Lastly, two movements are provided, one for photographing at the standard rate of speed, and a second for photographing one picture at a time for trick effects.

The lens of the professional motion-picture camera is many times faster than that of the average still-picture camera. Indeed, it will make perfect pictures in the shade, and even in rainy weather it will turn out fair pictures, although these are obviously not as clear as those produced under favorable conditions. Nevertheless, the high-speed lens permits of making pictures in what the amateur photographer would call "impossible" places.

Accompanying the camera is a heavy tripod, which serves to hold it as steady as a rock while the film is being exposed. In view of the fact that the camera is making a series of snap-shots of 1/25th to 1/35th second exposure, it seems rather strange that a tripod should be necessary. But the explanation is simple: In order that the pictures may appear perfectly steady on the screen it is necessary that the camera make each picture of a series from precisely the same position. Furthermore, so great is the degree of magnification of the pictures on the screen that a slight "play" in the tripod mounting results in an inch or more of "play" when the picture is projected. Indeed, the camera-man, like the careful machinist, is dealing with hundredths and even thousandths of an inch, and the screen checks up his work in a greatly magnified form.

The tripod is provided with a geared head which, by means of two handles, may be tilted at any angle and turned around on a horizontal plane. Not only does this tilting and panoramic movement permit the camera-man to follow a moving object, but it also enables him readily to point his lens at any given object, aiming the camera all the while by means of direct-view finder.

The Camera-man as an Artist

If ever there was a genius it is the camera-man, for, starting out with the camera just as it was turned over to him by the motion-picture engineers, he has forever been busy improving its mechanism here and there, and developing any number of accessories which have gone far to make films more attractive to the eye. The fact is that the average camera-man is an artist; but instead of pigments and brushes he relies on various mechanical contraptions designed and constructed during odd moments.

One of the first effects introduced in films was the "fade-in" and "fade-out," in which the film, perfectly black at first, gradually becomes lighter and develops into a perfect picture on the screen, and the reverse operation. This is accomplished merely by closing or opening the iris diaphragm of the lens. Some cameras are equipped with automatic devices which can be arranged to "fade-in" or "fade-out" a picture in 5, 10 or 20 feet. The camera-man merely sets the indicator and turns the crank without further attention.

Now the "fade-in" and "fade-out" effect has a most important application in joining two scenes, so that one literally flows into the other. This result is achieved by first "fading-out" one scene, noting the footage allowed for the operation. Next the film is turned back to a point where the "fade-out" began, and a "fade-in" of the new scene is made.

Numerous devices have followed the "fade-in" and "fade-out," since the camera-man discovered that there were other possibilities in film photography aside from the regular run of work. Film producers are ever ready to try out new effects, which, when they once appear on the screen, are immediately copied by competing producers whose camera-men after viewing the novel effects deduce the method probably used—or substitute their own.

A later-day effect is the "circle vignette," by which is meant the fading out of the corners and edges of a picture on the screen. While there are several ways of obtaining this result, the most popular appears to be the use of an iris diaphragm in front of the lens, which permits a circle of any size. As a variation of the "fade-in" and "fade-out," the circle vignette can be used to "circle-in" a picture and "circle-it" out again. Thus a picture on the screen suddenly opens up from blackness to a circle of ever-increasing size, until the rectangular outline is reached. The "circle-out" effect is just the reverse of this. It is possible to obtain either hard edges or comparatively soft edges on

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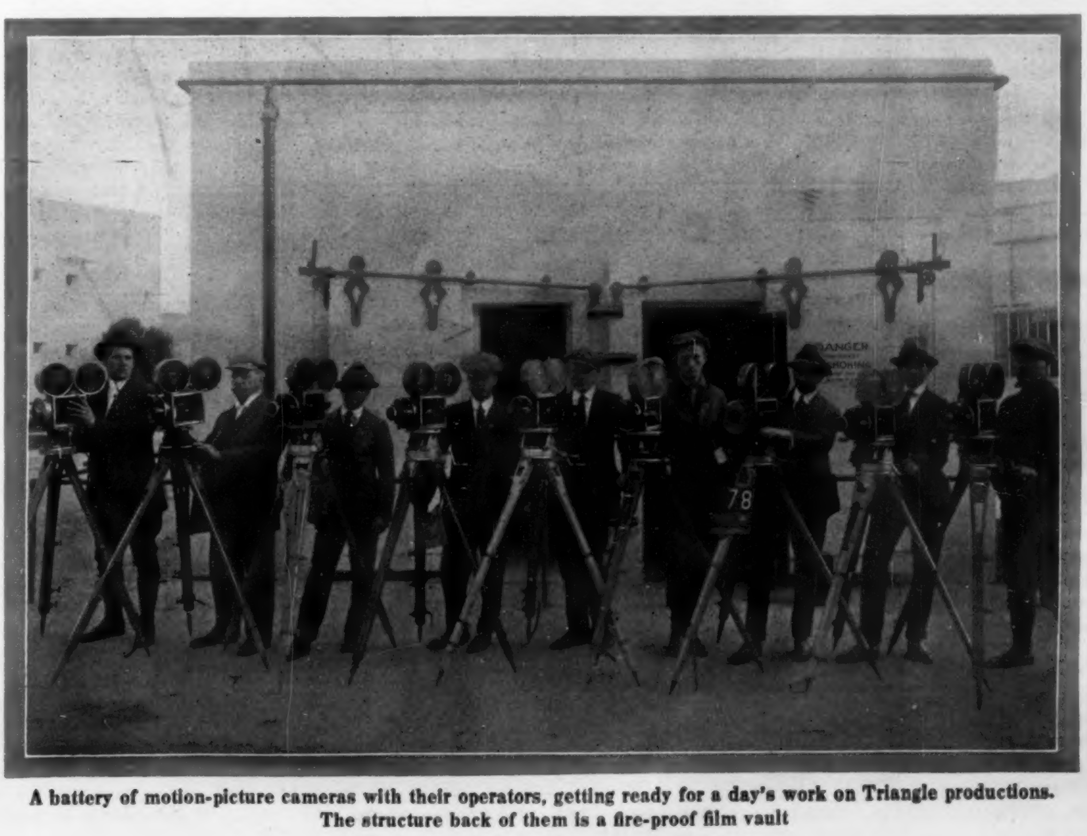
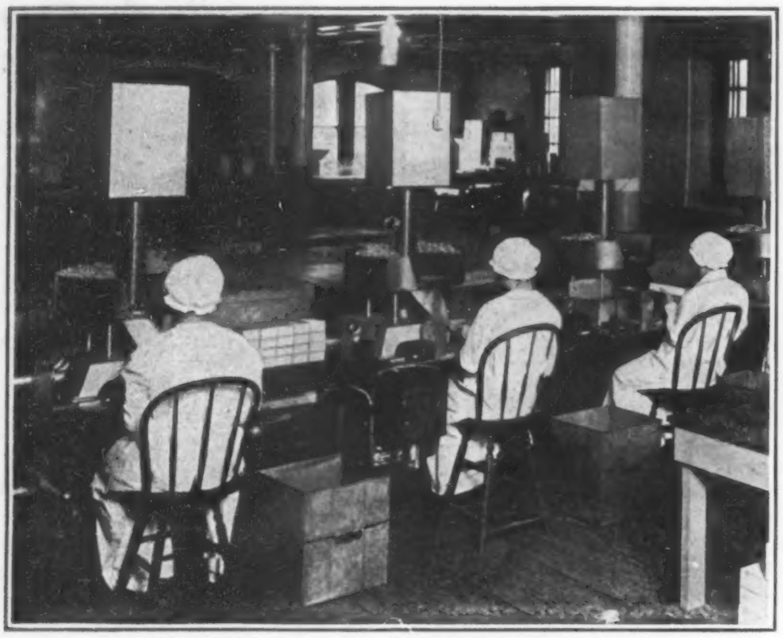
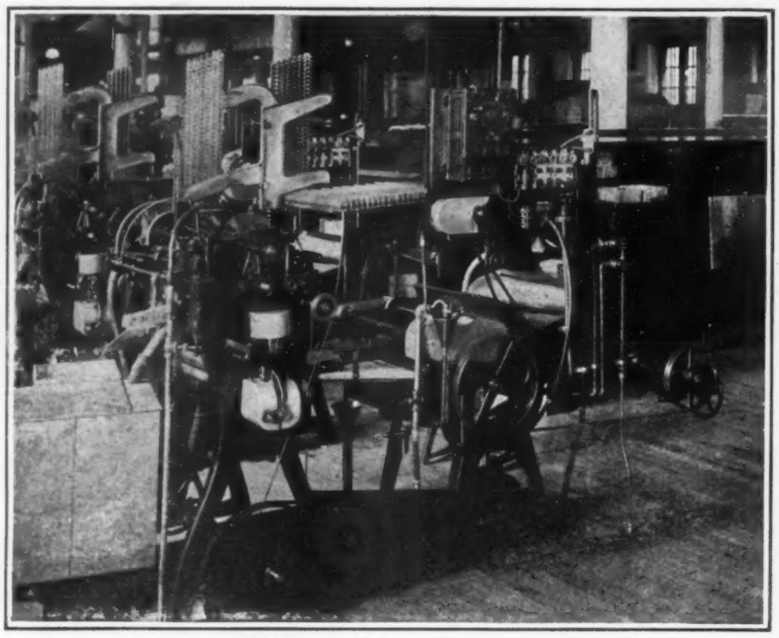


A battery of motion-picture cameras with their operators, getting ready for a day's work on Triangle productions. The structure back of them is a fire-proof film vault



Counting and boxing the gelatin capsules by machine



Automatic machines with which gelatin capsules are made

Glue Jackets for Disagreeable Medicines

How Gelatin Capsules Are Manufactured

By Harmon W. Marsh

FORTUNATELY for our comfort, the days when grandfather shoved his dose of quinine as far back in his throat as he could, on the handle of a spoon, and washed it down with a drink of water, are relegated to the past. We now take our disagreeable powders in capsules, and the making of these has developed into an industry of considerable proportions.

Dry capsules are made from a very refined gelatin, which is so expensive as to be prohibitive for cooking purposes. The supply was formerly obtained in France, but a grade is now made in Michigan that is superior to that produced elsewhere in the world.

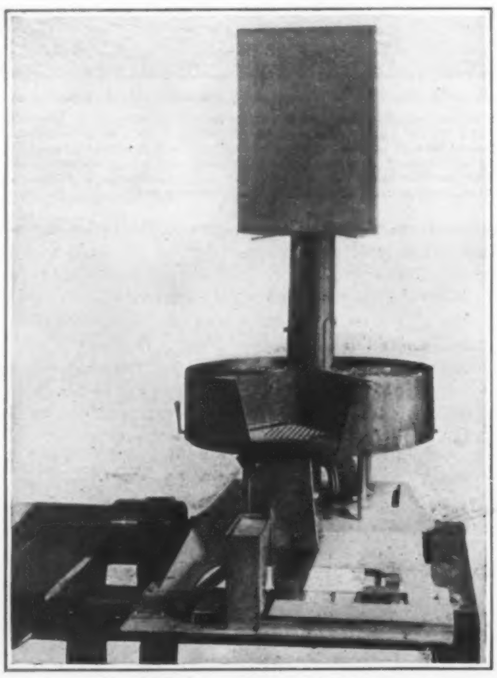
Gelatin is a very sensitive substance. It is delivered in thin slabs, three inches by eight, like glue. It really is a very refined glue, made from selected stock and manufactured with great care. If overheated it deteriorates to such an extent as to unfit it for medicinal purposes, and it will fail to dry properly, in capsule form, unless certain conditions of temperature and humidity are preserved. Furthermore, capsules must be absolutely clear and practically sterile when distributed to the druggist trade, which means that in all the processes of manufacture the gelatin must not come in contact with human hands.

The largest capsule factory in the world is that owned and operated by a firm of pharmaceutical chemists in Indianapolis, Ind. The output for each working day amounts to something like 2,500,000 capsules. This refers to empty capsules only.

Each parcel of gelatin received is subjected to rigid tests to insure its quality and absolute purity before it is admitted to the stock room. As required it is drawn from stock and soaked in cold water for three or four hours. The water is then drawn off and the softened gelatin placed in hot-water-jacketed tanks, to be melted. It is under constant supervision and the degree of heat must be regulated to a nicety. From the melting room the tanks are sent to the manufacturing department and the melted gelatin is distributed to the machines as needed.

These are ingenious and intricate affairs, some parts of which move very slowly, and independently, while others must move synchronously and with rapidity. They are electrically driven and are made solely for these manufacturers, who own all the patents. The pins of non-corrosive phosphor-bronze on which the capsules are molded are set in bars, thirty pins to the bar, and pass through the machine in pairs, cap and body forms side by side. The bars are carried on endless chains, with the pins upright until they are immediately over the gelatin tank. At this point they stop and the pins are turned down, while a small tank of melted gelatin rises and coats them. They then turn over twice to distribute the gelatin evenly, move ahead a few inches, turn over once more with a reverse motion and then pass into the curing chamber, from which they emerge in about an hour.

The gelatin tanks in the machines are kept supplied by an attendant and an even temperature is maintained by means of gas burners regulated by thermostats.



Close view of the counting and boxing machine

Baths for melting and dissolving gelatin

With the exception of one link which is purposely omitted to insure the constant watchfulness of the operator, the machines are entirely automatic.

When the bars issue from the curing chamber the gelatin coating on the pins is trimmed, stripped and the two halves forced together. The finished capsule is then blown into a receptacle by compressed air.

The product of each machine is being frequently tested with delicate callipers to insure uniform thickness in the capsule walls. Should any machine develop a tendency to make the gelatin coating a fraction too thick or thin, it is stopped until the trouble is remedied.

From the capsule machines the stock moves to sorting machines where all scraps or defective capsules are removed and the perfect stock is deposited in light, portable bins, capable of holding several bushels each. The stock then proceeds to the counting machines, where the operator feeds partially opened slide boxes into a hopper. Exactly 100 capsules are deposited in each box, the lid is closed, and the box is passed on a belt carrier to a girl who deftly wraps a dozen boxes in a neat package and pastes on the label.

Many sizes of capsules are produced in this factory, from the tiny little ones to huge horse capsules which measure ⅞-inch in diameter by 2½ inches long, of an ounce capacity. To meet the requirements of physicians who sometimes desire to conceal the nature of powders, or where alternate doses of different drugs are to be administered, a few capsules are colored brown, green, pink and frosted white.

The manufacturing room contains a battery of 50 machines, each with a capacity of about 50,000 capsules in eight hours. Each machine carries from 175 to 200 pairs of bars. The operators are all girls, and the visitor is impressed with their healthful appearance and fine complexions, due probably to the extremely sanitary conditions which of necessity obtain throughout the plant.

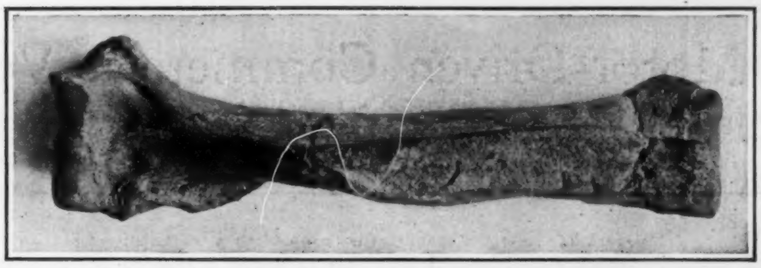
Chasers to Give Place to Destroyers

FOLLOWING the recommendations of the General Board of the Navy, the Navy Department has decided to place no more contracts for submarine chasers, but to build destroyers instead. This does not mean that the chasers are a failure; far from it. For they are excellent boats on patrol in the more sheltered waters in which the smaller German submarines are operating. The change from the construction of chasers to that of destroyers is designed to meet the developments of U-boat warfare, which have been in the direction of larger boats of wide radius of action, capable of operating far out in the Atlantic. To patrol properly the lanes of steamship travel for a distance of 300 miles or more from the French and British coasts calls for a boat of the size and seakeeping qualities of the destroyer. If the Department were wise, it would sacrifice every other form of new constructive work in favor of a big destroyer program calling for at least 250 of these craft.

The Biggest Bear Known

By R. P. Crawford

THE discovery of a humerus of what seems to be the largest bear so far known to have existed in prehistoric time is chronicled by Prof. E. H. Barbour of the University of Nebraska. The bone was found 11 years ago in the Pleistocene of Cass county, Nebraska, but because of its unusual size the find was not made public until after a detailed investigation could be carried out by scientists and a search made for further remains of the monster animal. Efforts to find other portions of the fossil skeleton proved unavailing, however, so recently the discovery was made public. According to Doctor Barbour the giant bear to which this humerus belonged was nearly twice as large as the great European cave bear and far larger than any of the bears known to have lived in North and South America in prehistoric time. The humerus measures 24.8 inches in length. It is estimated that Dinarctotherium, the name given to this bear, must have stood close to seven feet tall, or, even allowing for a very short forearm, a full six feet at the shoulders.



A two-foot forearm belonging to a gigantic prehistoric Nebraska bear

In many respects this carnivoral humerus seems identical with that of the cat family but because of its size such a classification has seemed out of the way to those who have studied the specimen. In such a case the animal would have had to be more than twice as large as the saber-toothed tiger of prehistoric time. "The entepicondylar foramen (the large hollow just above the joint at the left of our cut), a feature of consequence, though large, is relatively small when compared with that of cats," says Professor Barbour. "In the cat family this foramen is often three or four times as long as broad, but in the Dinarctotherium it is scarcely longer than broad. This foramen, common in Felidae, Mustelidae, and a few other groups, is wanting in Canidae and Ursidae, save such early bears as Arctotherium, the short-faced fossil bear." It will be seen that the name, Dinarctotherium, classifies this bear as belonging to the largest of the short-faced fossil bears. While in some respects the humerus appeared to be that of a giant member of the cat family, the weight of the investigation has seemed to lean toward classifying it among the bears. "It was a huge bear," says Professor Barbour, "capable of preying upon such contemporaneous mammals as the ground sloth, early bison, and even the mastodons and mammoths, especially the young or enfeebled." This opinion is endorsed by the authorities of the American Museum of Natural History.

Making Your Mark

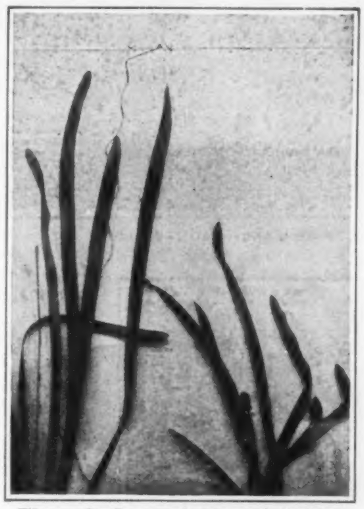
By L. B. Baker

IF a diamond be drawn across a piece of glass, its path is marked by a scratch, the deepness of which depends upon the amount of pressure exerted in the operation. This scratch, as we all know, is an actual rupture or tearing of the surface of the glass. Again, if a piece of lead be rubbed over a rough surface of steel a mark is made which, contrary to the conditions in the previous example, is composed of the marking material. Finally, if a liquid or semi-liquid composed of dye or coloring matters in suspension, or chemicals capable of reacting to produce color, be placed on a smooth surface and allowed to dry, we have the production of a kind of marking different from that in either of the above examples.

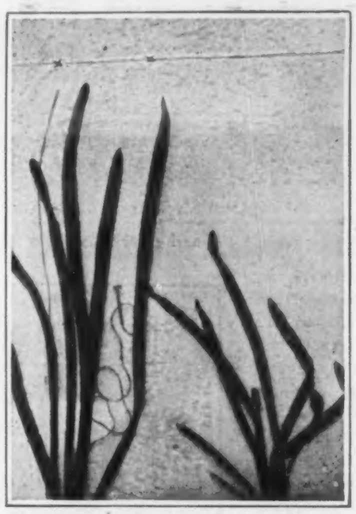
At first sight all three of these methods seem extremely simple in principle; and indeed, the use of a hard writing object upon a material softer than itself, or the application of dyes and colors, does not offer many perplexing problems for the physicist to explain. But the use of a material which by friction leaves on the writing surface a mark composed of its own substance is not quite so simple. In the first place, disregarding all writing materials which may be made of a sticky composition, it is extremely difficult, if not impossible, to write upon a hard surface, if that surface be smooth or polished. Evidently, then, one of the prerequisites is a writing surface to a greater or less degree rough.

A consideration of equal importance is the nature of the writing substance itself. This must possess the quality of yielding up very minute particles of itself when it is being drawn across the uneven surface of the material written upon. That all soft substances do not possess this property will be evident if an ordinary rubber eraser, appreciably soft to the touch, be drawn over a rough surface of steel. It leaves a mark far less visible than that produced under the same conditions of application by a piece of lead, far harder to the touch than the rubber. Many similar examples might easily be quoted; even in the case of the ordinary pencil, we are familiar with the apparent greater hardness of the graphite core of the pencil as compared with the paper.

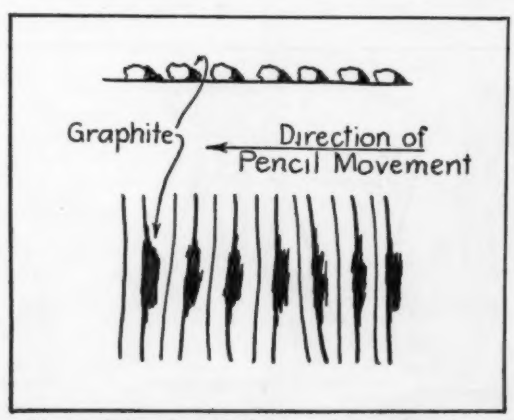
A closer examination will disclose the fact that the property really essential to a successful marking material concerns itself with the quantity of coherence existing between the minute particles of the substance, and the relative ease or difficulty with which they detach themselves from each other under the action of abrasion. For instance, the individual particles which go to make up the structure of a diamond are extremely hard themselves, and they are united to each other so strongly that ordinary abrasion on no known substance has the power to tear them apart. On the contrary, the core of a pencil is composed of a material the small individual units of which, although harder to the touch than the paper, are so loosely bound together that the abrasion caused by writing detaches them from their mass.



The male flowers become detached from their short stalks and rise to the surface



After fertilization, the long stalks of the female flowers curl up and bury the seed pod in the mud



Plan and elevation showing how the rough surface of the paper catches and holds the particles from the pencil

A pencil mark on paper, magnified 100 diameters

Under the microscope the surface of ordinary paper is seen to be very rough. The various fibers of which the sheet is made appear on the surface as a tangle of thread-like strands. Because these fibers are more or less rounded in cross-section there are slight depressions or pockets between adjacent fibers. It is these pockets which fill up with the pencil substance and make what we all recognize as the pencil mark. By referring to the photo-micrograph it will be noted that the pencil mark is not a continuous black line, but that it consists almost entirely of isolated pockets, as described above, each containing a little deposit of graphite. It will be seen, furthermore, that very little mark, if any, is left upon the fiber itself.

The direction in which the pencil is moving in the production of any one mark is always easily determined—the graphite deposit always is located on those sides of the projecting fibers toward which that motion is directed. This may be illustrated graphically as in the sketch herewith.

A Wonderful Water Plant

By S. Leonard Bastin

ONE of the most singular plants of Southern Europe is certainly the *Vallisneria spiralis*. The species is an aquatic one often occurring in great abundance in ponds and slow moving waters in Italy and France. The Vallisneria is a diecious plant; that is, its male and female blossoms are found on different individuals. The plan of pollination is peculiarly interesting. In the case of the female plant the stalk of the flower is very long, being in the form of a spiral. When the flower is ready for expanding the spiral untwists in such a way that the blossom is able to rise upwards and rest on the surface of the water, where it opens.

The male flowers, borne we must remember on different plants, are produced in a totally different manner. They are not solitary, but grow in large numbers on an axis that is enclosed in a kind of spathe. At a certain stage in the development of the staminate flowers the diminutive stalks, by which the buds are fixed to the axis, become detached. In their closed state the buds rise to the surface and at first float like small white pearls on the surface. Finally they open and the three leaflets that form the perianth are thrown back, and assume the appearance of boats all joined at one point. Only two of the three stamens bear anthers and these project obliquely up into the air. These curious little devices float about, and are blown hither and thither by the wind. A good number of them are certain to get stranded in the vicinity of one of the female flowers and, in such cases, the anthers deposit their pollen on the stigmatic surface.

Directly after the pollination is completed a strange thing happens to the female flower. The long flower stalk assumes a spiral form and, on this occasion, the coils draw so tightly together that the ovary or young fruit as it is now is brought down close to the muddy bottom. Here the development of the seed takes place amidst suitable surroundings.

The Current Supplement

ONE of the many serious problems that is occupying thinking men is in regard to the probable effect on the world of the loss of the many thousands of men killed in the war. This is dealt with in an extremely interesting article on *Some of the Evolutionary Consequences of the War*, which appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2176, for September 15th. *A Convenient Testing Machine* describes and illustrates an unusually compact and simple device for investigating the strength of materials, both in tension and compression, and especially for investigating load deformation. *Old Sundials* tells in a chatty way of curious old specimens to be found in England, and is illustrated by a number of sketches by the author. We have read much about the effects of the war on the hearts of the soldiers, but in the article entitled "*Soldier's Heart*" an English medical officer shows that there is no particular disturbance that can be rightly called by this name, but that it has been carelessly applied to a great variety of symptoms. *Proper Turpentining Methods* is a letter from a forest expert that refers to, and adds further information to an article on the same subject that appeared in these columns a short time ago. *Bread and Flour* is a valuable contribution to the food question, and contains much valuable information. Other articles of interest are *Marine Salvage Operations*, the conclusion of *Cytology*, and *The Modern Whale Oil Industry*.

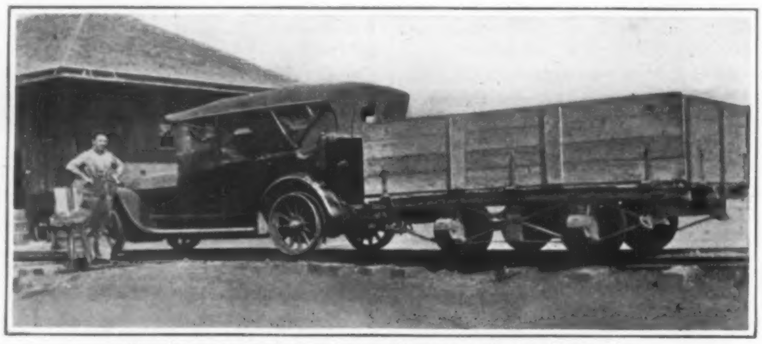
The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Touring Car Used as Locomotive

THE accompanying illustration shows an unusual application of a standard touring car which is in regular service as a locomotive over the line of the Warner & Webber Falls Railroad Company of Oklahoma. This railroad has a length of 12 miles, the distance between Warner and Webber Falls. The car pulls two freight cars over the 2½ per cent grade with loads from 5,000 to 25,000 pounds, making three scheduled trips every day, and sometimes several extra trips. Carrying these loads it takes from thirty to forty-five minutes to cover the 12 miles. It is the regular six-cylinder model except for the removal of the tires and use of the flanged metal wheels to fit the rails. The car can be converted into an automobile for road use in 30 minutes. It was driven 20,000 miles before being put into service as a locomotive. This railroad was the only one running between these two towns and after it failed, owing to high operating expenses the car was substituted. The car carries seven passengers in addition to hauling two freight cars. The passenger fare is 50 cents one way. Those operating the railroad say that they have never had one minute's trouble with the novel "locomotive" in the months it has been in service. It has not even been necessary to take out a spark-plug. They get from eight to twelve miles on a gallon of gasoline over the rails with this locomotive, the operating expenses being considerably less than with other power and of course, there is a corresponding reduction in maintenance costs. The automobile provides adequate service at minimum cost.



Touring car used as a locomotive on a short railway line

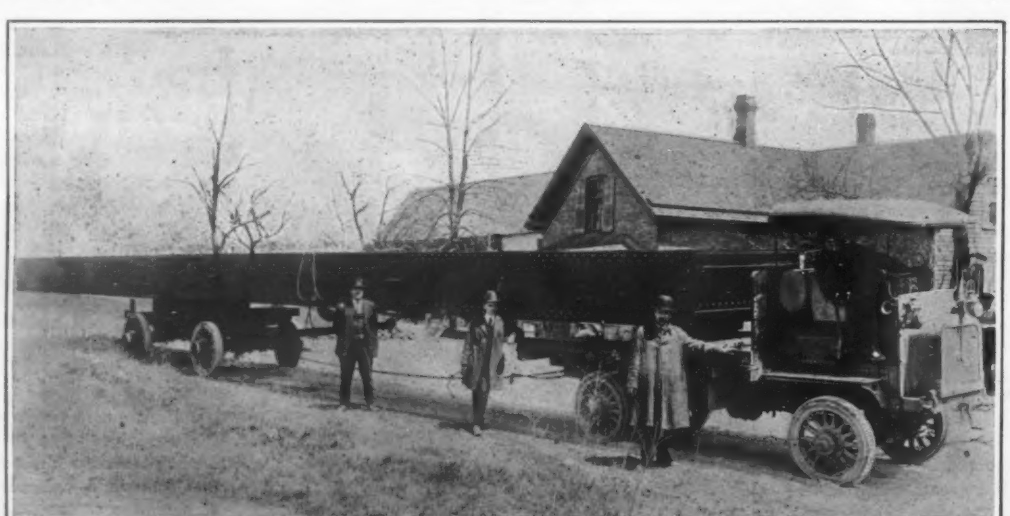
A Rear Car for Motorcycles

THE motorcycle in its modern forms is just as dependable a vehicle as its larger brother, the automobile and it provides a very economical means of transportation. Motorcycles with side car attachments are very common and the fitting of clutch control and change-speed gearing has made it easy for the relatively low powered motorcycle engines to handle much heavier loads than would seem possible. One of the latest attachments designed to increase the load-carrying capacity of the two-wheelers is a form of rear car that has its own independent wheels and axle. This attaches to the motorcycle in much the same way that a wagon is hitched to a horse. As the tractive pull comes in the center of the rear car, the machine does not tend to steer to one side as when a side car is attached and the combination is easily controlled. The outfit illustrated has been devised for military and police purposes and is known as a "riot car". Four men are easily carried on the rear car and one man on the motorcycle saddle. It will be apparent that a substantial delivery box could be substituted for the seats adapting the machine for commercial purposes. A special armored body with provisions for carrying a machine gun and two operatives, has also been devised by the makers of the form shown. The motorcycle can be detached in a few minutes and absolutely no change in its construction is needed to adapt it to pulling a rear car.

Motorcycle fitted with a "riot car"

Moving a Large Steel Girder by Truck and Trailer

IT is very fortunate that transportation has been able to keep pace with developments in building construction, as the greatly increasing size of the office buildings of our large cities has made it imperative to use structural steel members of great size and weight that could be moved only with great difficulty by ordinary methods of transportation. The illustration herewith shows a four-wheel drive truck of American manufacture coupled to a wagon of 30-ton capacity which was able to handle a massive 16-ton girder, 71 feet long without difficulty. The load was so great that in making its way through a cinder covered field the truck trailer would sink 10 or 12 inches into the ground. This proves conclusively that the 4-wheel driving system provides ample traction and applied power in a way that is of great value when extremely heavy loads are to be handled. The truck shown made the trip from the iron works to the point where the structure was to be erected, the distance being several miles, in much shorter time than a similar journey could be made by the old fashioned method of moving such heavy weights by means of a large number of horses, or by towing with a windlass actuated by horse-power.



Handling a heavy steel girder with a truck and trailer

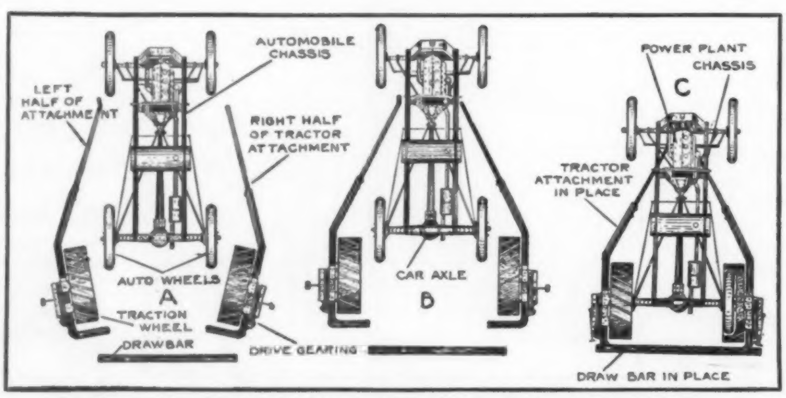
Tractor Attachment for Pleasure Car Chassis

A SIMPLE device has recently been marketed which should be valuable to the farmer owning a place of such size that he would not be warranted in purchasing an agricultural tractor, because it permits of adapting a very popular pleasure car chassis to tractor work with but little trouble. It is claimed that an attachment of this kind can be employed profitably for a wide range of work now done by horses, such as plowing, disking, harrowing, seeding and hauling binders, graders, road drags, etc. The regular car speed of a possible maximum of 40 miles per hour is reduced to a farming speed of about two miles per hour by special reduction gearing carried independently of the automobile chassis. So great a multiplication of power is provided that the engine does not need to be run to anywhere near full speed to develop all the power needed. It is said that an engine speed of about 1,000 rotations per minute will permit the converted machine to do the work of three or four horses.

The attachment does not disfigure the car, and as the supplementary reduction gearing is all carried by the attachment no perceptibly greater strain is placed on the chassis than when it is used on the road at a corresponding engine speed. The attachment pushes the car along, as the automobile chassis simply furnishes the motive power, the attachment providing all the traction. All work is done with the change speed gearing locked into high gear. It is stated that the device can be attached to a chassis in 10 minutes and removed from the car in half the time.

The machine is designed along practical mechanical lines, all frame members being of angle steel. The wheels are built up of rolled steel rims and steel spokes and have cleats or grouters riveted to the rim to increase traction. The wheels revolve on large anti-friction bearings. A supplementary water tank should be provided to prevent the engine from overheating while the device is used.

The accompanying illustrations show clearly the method of installation. The view at *A* shows the device in such position as to permit backing the car chassis between the two sections. At *B* the car is shown in place between the sections and forward members of the attachment, with the latter ready to be pushed under the car. The view at *C* shows the attachment in place.



Converting a light car into a heavy duty vehicle with a simple tractor attachment

The construction is such that the wheel hub, provided with special driving lugs fits into the recess in the hub of the attachment. After both sections are in place, a draw is used to tie them in position and keep the automobile wheels firmly secured in wheels of the attachment. The front ends of each section are joined to the other by bolts and then attached to the front axle by a "U" bolt fitting. The device may also be secured with a belt attachment should it be desired.

The power from the wheel hubs passes through a train of reduction gears on each section and the traction wheel speed is greatly reduced as compared to the auto wheel speed.

Submarine Problem XIV.

(*Concluded from page 188*)

forming combustible, keeps its fuel under water until used, when it is ignited and fanned out into the air by means of a blowing apparatus. The blower is inexpensive (about $125) and the smoke boxes themselves cost in the neighborhood of $25. The smoke thus produced is of a creamy white consistency, and of course spreads out over a large area.

Another type is a rectangular box with a strip of a material resembling adhesive tape about it. This, when peeled off, reveals a slit through which the fire is applied, after which reddish black smoke pours forth. And still other types exist.

Smoke boxes are used in various ways and for various purposes. If a ship has reason to think she has been observed and has been pouring a thick black smoke from her funnels, she may elect to change immediately to anthracite coal and to throw overboard a smoke box. The low angle of vision possessed by a submarine, whether from periscope or from surface floating position, makes it extremely difficult to determine at a distance whether a source of smoke is a smoke box on the water or a smoke stack from a hull-down vessel.

Smoke boxes may be hoisted to a mast, to produce a quick spread of a smoke screen, and the vessel simply turn tail and run, or the smoke box may be mounted on the stern. In such an event, the screen acts simply as a preventive of a torpedo being fired, and the vessel must depend on her speed to outrun the submarine. No submarine commander is going to fire a valuable torpedo at the stern of a fleeing vessel unless he is pretty sure of a hit, and a smoke screen makes a hit under such circumstances entirely a matter of chance.

Smoke boxes produce smoke for 20 minutes, perhaps for half an hour. To carry enough to keep a smoke screen going indefinitely would not aid safety to any great extent. When a submarine sights a vessel one of two things happens—she either catches up with her victim and torpedoes her, or the intended victim makes her escape. If the escape is not to be made in the time provided for by a dozen smoke boxes, it probably can't be made. If the two vessels have an equal speed, all that is necessary is for the submarine to run after the smoke until it is exhausted. And it should be noted that if a smoke screen prevents a merchant vessel from being fired upon successfully by a submarine, it also prevents the gun crew of the vessel from making the submarine keep to an awash condition—and a submarine goes faster on the surface than under water.

Obviously, much will depend not only upon the relative speeds of the hunter and the hunted, but the time of day at which the hunt begins. Attacked in the early morning, a smoke box protected steamer has far less chance of making her escape than if the danger comes in the afternoon. Night is the great friend of the submarine-beset merchant vessel, and can she but avoid a torpedo by zig-zagging, by smoke screens or by a camouflage protection which renders her of low visibility until the afternoon, she will have a vastly increased chance of merging safely into the dusk than her sister ship who is so unfortunate as to raise a periscope at sun-up.

No contention is made that either camouflage or smoke box is an adequate treatment for submarinitis. At best they are but antiseptic measures designed to minimize rather than to cure the illness. But because they can be quickly applied, are inexpensive, and to a certain degree, effective, they represent, on the part of the Government which requires them, the most satisfactory minimizing treatment for the poisonous ill afflicting alike the sea and her ships, that has as yet been discovered.

Unquestionably, the underlying principles of ship protective coloring will be worked out, by experiment and observation. Probably ships will be lost before this or that method is proved ineffective. But the experiments, if cumbersome to carry on, and slow in their progress, are being made, and it seems highly probable at this writing that within a comparatively

short time a system or systems of painting will be definitely decided upon as the best possible compromise between a dark sky and a light one, a dull sea and a bright one, a morning light and an afternoon one, a position against the sun and one with direct sunlight falling on the vessel.

Lengthening the Life of Wood

(Conclude from page 189)

oil per cubic foot. While the contract depth for piling is usually three-quarters of an inch, it is quite possible, by continuing the process for a sufficient length of time, to force enough oil into the wood to make it sink in water. The vapor given off from the retort is drawn through a condenser into a hot well by a large vacuum pump. From the hot well it is discharged into a separating tank where such oils as are valuable are separated from the water.

The engine room, which contains all necessary pumps, generating machinery, etc., is located directly above the retorts on reinforced concrete foundations. Its most interesting feature is an elaborate system of automatic recording apparatus, a steam meter showing the amount of steam consumed, thermometers, pressure gages, and the like. By means of these ingenious devices, a complete record of temperatures and the processes of the entire plant is made on circular disks from day to day. The records cover each a period of 24 hours, and are filed away for future reference.

The creosote tanks have a capacity of nearly two million gallons of oil. They are located near the water front so that the oil may be pumped directly from the steamers into the tanks.

There is another and less effective process of creosoting that practically consists of the old open tank method of boiling the timber in hot oil until dry, and then pressing in the oil. Its disadvantage is that the uneven distribution of the moisture in the timber results in a burning of the dry portions before the wet parts are dry.

The creosoting industry is still in its infancy, but the great strides being made are in no small degree due to the experimental stations maintained by the United States Forestry Department. This has resulted in a development of the business from the scientific standpoint.

Plant Products for Every Purpose

(Concluded from page 190)

siderable degree. Though agricultural, botanical and industrial data thus brought together in a systematic manner have a lasting value, in the present crisis they would not serve the purpose if they were not supplemented by all available statistics concerning the importation and exportation of each product. Part of these data are readily obtainable, but in the main reliance must be placed in the commercial firms themselves for coöperation and support in this branch.

Last, but far from least in importance, is the reference library department. Adequate cross reference catalogs containing citations of the best of the published data must be on hand and kept thoroughly up to date.

This brief outline covers in a general way the plans and aims of the Committee, though of course there are many ramifications of the work that have not been touched. Perhaps therefore we may appropriately give a few specific illustrations of how such botanical work as it has undertaken or will undertake can aid industry.

A new industry has been established in the United States, dealing with a wood one-half the weight of cork. As soon as the existence of this wood was made known to the manufacturers, it goes without saying that there was a lively commercial demand for it.

Several fiber equivalents for specific purposes have been suggested in place of others which have been cut off from our list of imports by the war. These have satisfied every expectation in an admirable manner.

Many woods which were formerly brought into the United States in the form of completed manufactured articles are no longer to be obtained. In several cases of

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this sort, samples have been identified and, on the basis of exact knowledge thus acquired, satisfactory equivalents of which there was an adequate supply in this country have been suggested. In each of these cases the product desired was duplicated to the entire satisfaction of the customer.

The supply of several important drugs is exceedingly low. The Committee is making an earnest endeavor to remedy this situation. In one case a supply of the wild plant unknown to the trade was discovered It is hoped that similar cases may arise. In another instance an investigation was put under way which resulted in the discovery that several related species could be made to yield the same drug. In still other cases arrangements have been made to have a sufficient quantity of the plant cultivated to supply all domestic needs. It is necessary here, however, to issue a warning against well meant efforts of individual cultivators to meet the shortages on their own hook. There is hardly a drug of which the consumption is so large that one producer would not be able to grow enough to upset the whole market; so prospective growers would do well to consult the Committee before planting.

Information has been given several commercial concerns relative to the properties of condiments, spices and vegetable oils and fats now being offered by foreign countries for the first time to replace those at present on the market. It goes without saying that in some cases this information has been favorable to the purchase of the proffered article and in others not, and that in either event the American consumer and dealer have been benefitted.

Efficient and cheap fungicides and germicides have been suggested to replace those now off the market entirely or offered at a prohibitive price, for use in certain commercial products especially subject to this sort of attack.

The Committee appeals to all who can furnish data of value to communicate with it at the Bussey Institution, Forest Hills, Mass. In such an extensive work as this every item counts, and what seems, to the person knowing it, the most commonplace and obvious thing in the world may be just what the Committee needs to round out its information in some critical region of the industrial field.

"Shooting" the Photoplay

(Concluded from page 193)

the circle vignette, depending on how close the iris diaphragm is placed to the lens.

Screens of various materials which do not cut off all the light rays, are being used by camera-men. The most popular of these screens are prepared from ordinary portrait film, which is cleared or made transparent and then dipped in some dye. When the film is cleared and colored, a hole is made in the center or at any other selected point. Another way is to use sensitive portrait film, which is exposed to the light and developed to the required point, fixed, washed and dried in the usual manner. It is then shaped to meet requirements. Still other screens are made from fine wire netting.

Double exposures, which are a source of never-ending wonder to a layman, are produced in one of two ways. The first is by means of companion matts, which make it possible to expose different parts of the film. Thus with matt No. 1, for instance, everything is exposed on the film rectangle with the exception of a small circular patch. When No. 2 matt is inserted, the lens is covered and the film is wound back again to the point where the first matt was introduced. Then the lens is uncovered and the new matt, covering every portion of the film which was previously exposed, only permits the light rays to strike in the circular patch.

In scenes where the same actor appears twice at one time the effect is secured by the careful use of matts. First the man is placed on one side of the stage, and his actions are filmed on half of each rectangle or "frame" by means of the first companion matt. The second matt is then substituted, the lens covered, and the film wound back, and the actor takes his place on the other side of the stage. The film is again exposed, this time with the first half matted out. In order that the action at

both times may synchronize in the finished film, the director notes carefully the time at which each step in the action takes place during the first filming, and during the second filming the actor is coached so as to have the action synchronize with the preceding action.

The second method of obtaining double exposures consists in the use of a matt for the first filming, in order to reserve a part of the film for the second exposure which is handled by the use of a black velvet background for the stage. Or if there is apt to be a dark space in the scene, no matt is used. The player, acting before such a non-reflecting background, photographs on the film, while the remainder of the film with its previous exposure remains untouched.

Retouching Players and Scenery for the Camera

In photoplay production everything is considered in terms of black and white. To this end the sets are usually prepared in black, brown and blue.

White — straight white — is generally avoided in sets because of its strong reflection and consequent hallation on the film. Instead, a sky-blue or a light, lemon-yellow is substituted for white; so that we find sky-blue or lemon-yellow sheets and pillows and sheets, table cloths and napkins, and furniture covers. Even the actors wear sky-blue or yellow shirts and ties and cuffs, and the motion-picture bride is generally garbed in a brilliant lemon-yellow gown!

Motion-picture makeup is totally different from the usual stage makeup; for in the first place carmine must be sparingly used since it photographs a dead black. Beautiful pink cheeks must be sometimes toned down for picture purposes by the liberal application of cream-tinted powder; otherwise they would appear black and present a hollow appearance—an ideal consumptive type when photographed. Here and there the feature must be strengthened by a touch of the blue pencil while the eyelids, to show at all, must be heavily coated with cosmetic and lamp black.

Where Profit or Loss is Determined by the Sun

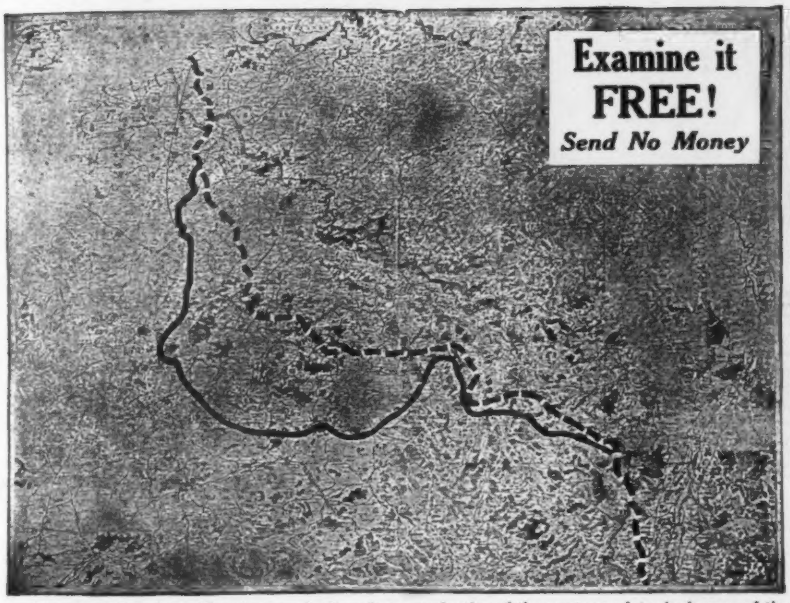
If the farmer depends for his profits upon the mercy of the elements, surely the camera-man depends upon the sun for his daily bread. Without sunlight he cannot make good pictures outdoors, so, quite naturally, it did not take him long to cast about for a location where the sun was most dependable. His quest ended in the southwestern part of the United States.

Sunlight can be counted on at least three hundred days of the year in the region of Los Angeles, in southern California; and the quality of the light is probably unexcelled in any other part of the country. Its actinic properties leave little to be desired; for films made there are literally as clear as a crystal. Besides, there is a wide variety of natural scenery available in that locality, ranging from tropical backgrounds at sea level to arctic backgrounds on the mountain tops.

Because of the wonderful climate a California studio consists of little more than an outdoor stage, with a simple wooden floor and a simple wooden framework on top of which move shades or awnings acting as sunlight diffusers. On the other hand a studio in the East means an elaborate steel structure with glass sides and a glass roof, crammed to overflowing with various forms of lamps for supplying artificial daylight.

Nevertheless, daylight studios or electric studios, as they are called, are not totally indispensable, even in the balmy climates. It sometimes happens that a camera-man is compelled to resort to artificial illumination. This is especially the case where a production has to be rushed to completion in a limited time, and the players must needs work after sundown.

After all, a photoplay is nothing more than a photograph. Whether or not it tells a story and tells it well is quite another matter. Fundamentally, it must be a good picture, for the motion-picture art today expects nothing but the best in photographic achievement. Which means that it is squarely up to the camera-man.



Size 28 x 36 inches—The photograph above is a reproduction of the most complete single map of the Western Front ever published. It is 28x36 inches in size, but folds into a convenient cover 5½x7½ inches, just right to be carried conveniently in the pocket for frequent consultation. It is printed on excellent paper, and can be had mounted on cloth if desired at slight extra cost.

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A Complete Index Makes Locating Easy

An index of towns and villages accompanying a map of this kind has been proven *an absolute necessity.* The smaller towns are the ones usually mentioned in the news dispatches. They are not to be found *on ordinary maps*, and the locations of most of them were, and still are, utterly unknown to the general public, but unless their locations are known their strategical importance cannot be grasped.

Nothing is more unsatisfactory than searching all over the map for a small place that may or may not appear upon it. However, this *loss of time and patience is now at an end*, for the index which *accompanies this map* makes it *vastly more useful and valuable.* The index contains more than 7,000 names. An idea of the importance of this statement may be gained from the fact that 90 per cent of the war maps available today contain less than 500 names. This index is bound in with the map and enables one to locate *instantly* any one of the 7,000 places mentioned.

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SCIENTIFIC AMERICAN

SALVED VESSEL CRASHING THROUGH THE BULKHEAD ERECTED TO KEEP OUT THE SURF—[See page 205]

September 22, 1917

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